The Science Teacher

Museum Junior Curators at Work—Los Angeles High School
(See Page 66)

IN THIS ISSUE . . .

Graphoid Surfaces and Their Application - - - 57
Challenge of Atomic Fission to Science Teachers - - - 60
This and That - - - - - - - 61
The Science Masters Association - - - - - - - 62
Microbiological Vitamin Assay Methods - - - - - - 64
Museum Junior Curators Have No Time for Delinquency - - 66
Ionization - - - - - - - - 68
A Home-Made Storage Battery and Charger - - - - - - 69
Social Responsibilities of the Scientist - - - - - 70
A Seasonal Change Direct Ray Apparatus - - - 72
Syracuse University Science Congress - - - - 74
Experiences of One Westinghouse Scholarship Winner - - - 78
Photo Club Activities - - - - 80
An Elementary Science Program - - - - - - - - 81

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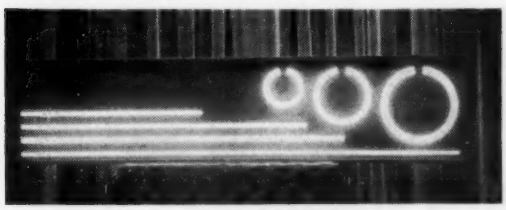

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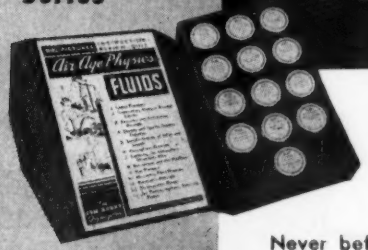

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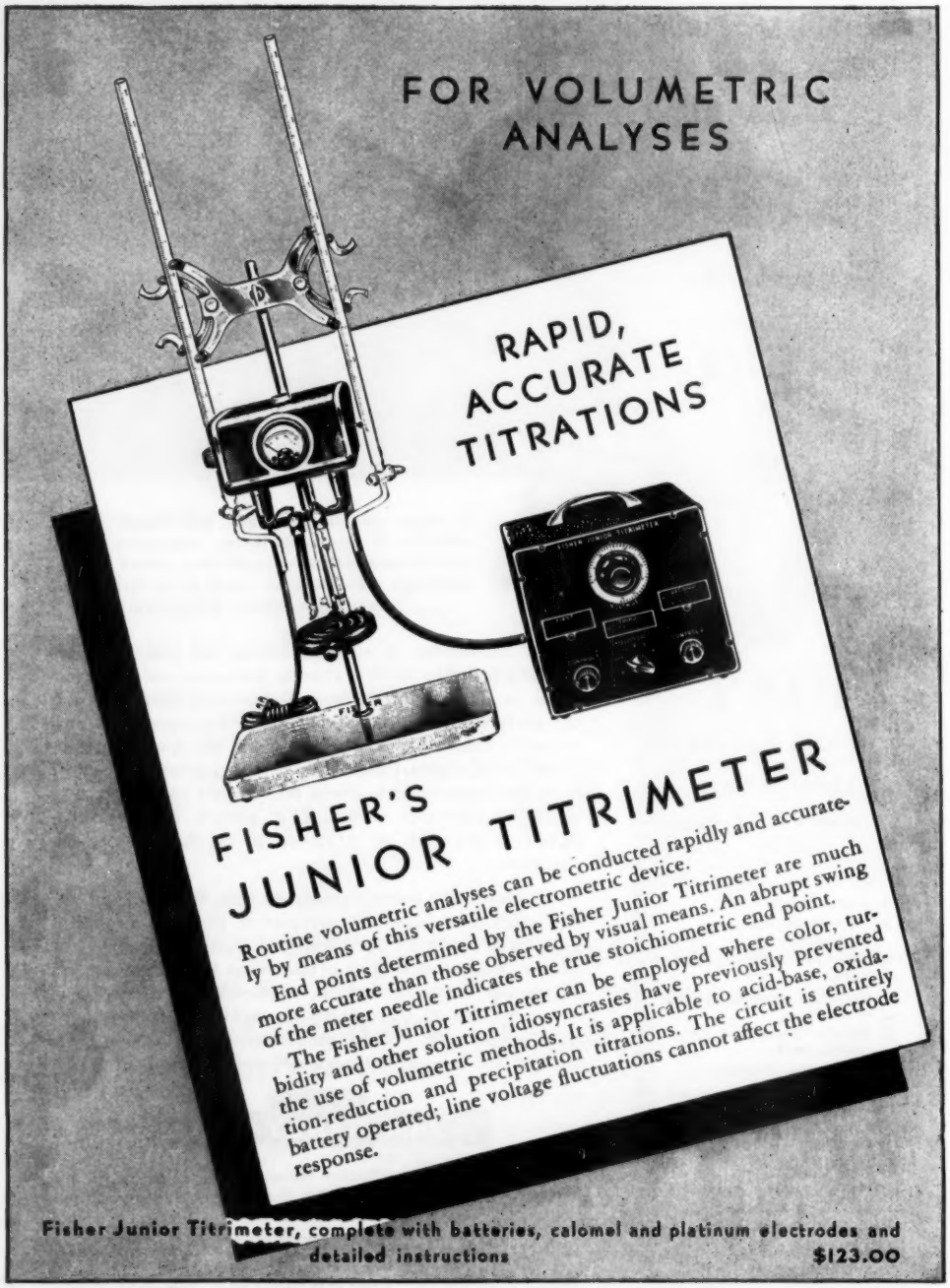
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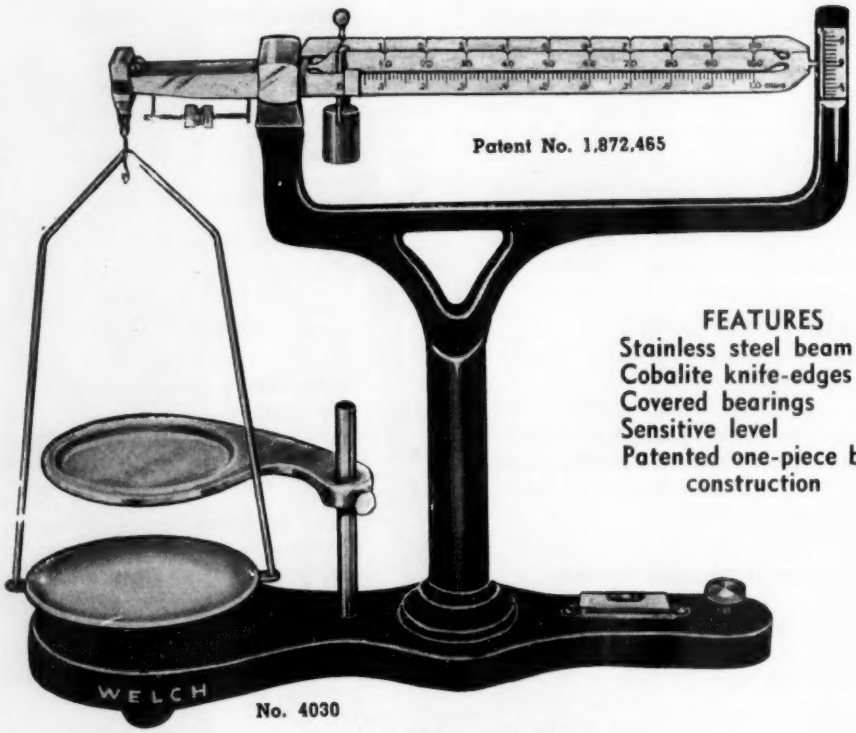

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Graphoid Surfaces and Their Application

R. K. CARLETON

Rhode Island State College Kingston, Rhode Island

BASED UPON his work on silicon carbide, *Carborundum*, Edward Acheson invented the first successful process for the commercial manufacture of artificial graphite in 1896. It was not until ten years later, in 1906 however, that he undertook to enhance the utility of the natural lubricating properties of graphite by dispersing it in mineral oils.

As early as 1913, Mabery explained in the following statement how colloidal-graphited oils form microscopically invisible films on friction parts: ". . . by reason of the particle tenuity or fineness it penetrates the porous surface of metals and coming into such close contact in their intermolecular structure, approaches a condition of graphite combination." There is no question but that this *graphoid* surface is responsible for the advantages that graphited oils possess over plain lubricants. Modern research methods, employing such tools as michrochemical analysis and electron diffraction techniques have detected this heretofore unseen *graphoid* surface.

Michrochemical Analysis

In a private communication two workers, Matthews and Wolf have shown that the thinnest possible shaving removed from a graphited surface has a much greater thickness than any adsorbed film of oil/graphite. Using michrochemical methods of analysis, they determined the total graphite carbon content of Armco steel, a low carbon alloy. By means of a lathe, a layer 1/2700 of an inch thick was cut from a graphited shaft, scrupulously freed of the lubricating oil by the use of solvents. The data in the following table shows significantly that the content of the shavings from the graphited surface is 50% higher than that of the untreated metal. These data are shown in Table I below.

TABLE I

Type of Surface	*Per cent Total Carbon*	*Per cent Total Carbon*
Oildag Treated Shaft	0.028	0.009
Non-graphited Shaft	0.0155	0.0055
Original Steel Shaft	0.016	0.006

A more marked increase of 75% is noted in the total carbon content of the steel surface after running-in with a graphited oil. Moreover, it will be noted that whereas 0.012 and 0.003% is the increase of total and graphitic carbons respectively, 0.009% of non-graphitic carbon has been added as a result of the treatment. From this investigation it was definitely shown that the *weight* of adsorbed oil in a 1/2700 inch layer is more than three times that of the irremovable graphite held physically on the steel. By calculations not given here, it has been determined that the *thickness* of this adsorbed oil film is ten times that of the retained graphite. The investigators therefore, conclude "that, during the process of running-in a metallic frictional surface with a colloidal-graphited oil, a very thin deposit of graphite is gradually formed on this surface and that this layer, owing to the well known affinity of oil and graphite, has the power of adsorbing an amount of oil several times its bulk, the steel surface in the presence of the graphite, perhaps also playing a part in holding a very thin film of oil."

Electron Diffraction Studies

THE RESULTS obtained by Matthews and Wolf through microchemical analysis have been pretty well substantiated through the work of Jenkins, in his application of the dif-

fraction method, in a series of experiments, by applying a colloidal-graphited oil to a specimen of Swedish iron. He succeeded in forming a graphoid surface on the metal by rubbing it backwards and forwards for a period of three hours on a flat iron table. The specimen was then thoroughly cleansed with benzene before taking electron diffraction patterns. The views obtained showed both graphite and iron rings of varying intensities, thus bearing out the contention of Matthews and Wolf, that an adsorbed graphoid surface was formed on the metal by this treatment. The continued presence and undiminished intensity of the graphite ring system of the pattern, as taken after rewashing the metal with alcohol and ether, indicates the marked tenacity of the film.

Research studies have corroborated further the conclusions of the above mentioned investigators. These studies have been conducted by Jenkins, Finch, Wilman and others who subjected metallic specimens treated with colloidal-graphited oils to severe rubbing action. Diffraction patterns then taken of the modified surfaces showed in each instance that the rings due to graphite layers broadened, while the rings made by the metal itself were nearly suppressed. These findings indicated that under conditions of stress the film covers the metal entirely while the crystals are reduced in size. At the same time the graphite particles composing it tend to orientate so that their main cleavage planes are in the plane of the specimen.

THE BEHAVIOR of a graphoid surface when functioning under conditions of dry lubrication is similar to the orientation effects observed in dehydrated films of aqueous colloidal graphite. Orientation by mere adsorption and evaporation of colloidal graphite from carriers has been observed by both X-ray and electron diffraction methods.

It should be carefully emphasized that the pronounced adsorption and orientation of colloidal graphite particles on surfaces in contact with graphited lubricants result in a large increase in covering power over that of a non-colloidal graphite. The lamellar particles of a colloidal graphite lie flat to cover as much of a surface as possible, whereas the coarse solids of non-colloidal preparations assume random disposition and, therefore, possess less covering power for the same amount of material. Current practice in this country and abroad indicates that 0.2% by weight of colloidal graphite, dispersed in a chemically neutral mineral oil is sufficient to form a graphoid surface of optimum coverage in the majority of applications.

Effect of Graphoid Surfaces on Wetting, Spreading and Retention of Oil

IT HAS BEEN calculated that a graphoid surface retains a weight, volume and thickness of adsorbed oil film three, eight, and ten times respectively greater than itself. These findings verify the claim that colloidal graphite assists the wetting and spreading of oils on metallic surfaces. Especially important is the fact that the graphoid surface holds oil tenaciously to itself.

Experimental evidence points out that the greater the oiliness of a lubricant, the better the lubricant is adsorbed to a bearing surface. In other words, an oil that exhibits a low interfacial tension with a bearing, wets the latter better and is therefore more difficult to remove. This adsorption factor is promoted by the marked attraction existing between graphite and oil molecules. Bachmann and Brieger measured this value in the course of their work on heats of wetting and found that the forces acting between graphite and oil are from seven to ten times as great as those existing between metal and oil. This oleophilic characteristic accounts for the ease with which oils are wiped from it. In this connection it has been estimated that an oil film adheres 10% better on a graphoid surface than on a plain metal face. It appears then that graphoid surfaces were primarily to hold oil in place than to act as an antifriction body. Should extreme pressures eventually rupture the lubricant however, the physically retained graphite will provide lubrication until the oil film is restored.

OF SPECIAL significance is the fact that addition agents to promote oil adsorption is unnecessary in mineral oils that are used as carriers for colloidal graphite. Wells and Southcombe point out for example, that small amounts of fatty acids have been widely employed to increase oiliness, though continued

research indicates that the liability of a lubricant to oxidation and deterioration rises as its oiliness characteristics increase. On the other hand, a graphoid surface anchors an oil film to a chemically inert graphite layer and does not demand that an oil should be fatty or that its molecules be otherwise made active.

The work of Trillat in this connection should be referred to. While investigating the adsorption and spreading properties of boundary films, he polished and cleansed a steel plate and applied to its surface a quantity of stearic acid solution, composed of highly polar molecules. In this simple test, the acid did not wet the metal but rolled around on the plate without adhesion. On the other hand, if the identical surface were oxidized, the fatty acid immediately wetted the steel and spread out in a layer that presented regular stratifications. It seems quite obvious then that, if the maximum wetting and spreading of this treated oil is to occur on frictional parts, the surface should present or approximate an oxidized state. Trillat stated further, that the crystalline nature of an established graphoid surface provided the necessary condition. He confirmed this by demonstrating that perfectly polished plates immersed cold in *oildag* assumed a layer that was capable of being completely wetted by the polar groups of the fatty body. X-ray examination showed that the acid orientated and stratified itself on the oil/graphite film.

IN ADDITION to encouraging the retention, wetting, and spreading of oil, graphoid surfaces retain the low friction properties of the graphite of which they are composed. Moreover, since colloidal graphite is an inert, soft and non-abrasive material, graphoid films are endowed with the same characteristics.

Hence they are capable of serving as efficient dry lubricants in the event of failure or temporary interruption of the oil supply. In addition, electric furnace graphite, whether in the colloidal state or in the powdered form is adhesive rather than cohesive, with the result that there is little danger of the films building up to appreciable thicknesses. Finally, having greater cohesion in the direction of the hexagonal planes than normal to them, graphite resists squeezing out under compression.

Some Practical Application of Graphoid Surfaces

1. *Run-in* and *Assembly*: Despite excessive pressure due to small clearances in new machinery, the tendency of opposing high spots in the surface to pierce the oil film, and the pressure of abnormally high friction heat, the colloidal graphite ingredient of run-in lubricants provided adequate lubrication. The usual practice is to smear a running-in compound containing colloidal graphite on the working parts of mechanical devices before or during assembly. Such a procedure is especially advantageous in the case of automobile, aircraft and other types of internal combustion engines. Manufacturers of compressors, pneumatic tools, reduction gears, etc., likewise employ graphited lubricants. The reason for this is better appreciated when it is realized that under the light loads of normal running-in, the bearing stresses concentrated on submicroscopic peaks rising above the bearing planes, result in intense local heating. When temperatures as high as the melting point of the metals are developed, there is a flow about the top and down the sides of the projections which on escaping the stressed regions cools with a non-crystalline structure. As running-in progresses the depressions of the friction surface eventually become filled with amorphous material until upon completion of an ideal treatment, the whole bearing surface is covered by a thick layer of *flowed* metal.

If a graphited lubricant is introduced during the process the minute colloidal particles form orientated layers at the points of contact. These infinitesmally thin lubricating films for the reasons already given, facilitate the motion of the surfaces because they possess a relatively small component of shear. Therefore, danger of oil contamination through *pick-up* or by the stripping of metal particles from surface projections, is materially decreased. In addition, friction is reduced and metal-to-metal contact minimized.

2. *Normal Operation*: *Oildag* is an excellent lubricant for use in internal combustion engines and industrial machinery. As an ad-

Continued on Page 83

The Challenge of Atomic Fission to Science Teachers

BERNARD JAFFE

James Madison High School Brooklyn, New York

ON AUGUST 6, 1945, less than seven months ago, President Truman let the peoples of the world in on the most closely guarded secret of the war. Half a century of dreaming and tinkering had ended in a surge of concentrated, cooperative effort, and the secret of the atom's structure was unveiled. The colossal energy of its nucleus was unleashed.

It was the most dramatic and awesome announcement in the whole history of science. Uranium's nuclear energy had almost instantaneously and completely obliterated an enemy city of 360,000 people. The destructive power of this new discovery was so overwhelming that the atom bomb, within minutes, became the all-absorbing problem of millions. For never before had such an achievement been revealed to the world where the dissemination of news was so rapid and widespread.

There had been other revolutionary milestones in the progress of science, but none shook the world more quickly and more profoundly. For example, when Copernicus in 1543 destroyed the geocentric theory of the universe by establishing the heliocentric conception with the sun at the hub, and the earth and the other planets revolving around it, the foundation of one of man's most deep-rooted beliefs was shattered. It was a terrible blow to man's pride when it was shown that *his* was only a minor planet, and not the principal focus of all creation. This was a turning point in the history of civilization, but its effects were confined, and spread very slowly. There was plenty of time for the world to adjust itself to this new intellectual revolution.

Less than half a century later Galileo performed a simple experiment and chalked up another basic advance in human thought. Aristotle, centuries before, had taught that objects fall at different speeds. Galileo refused to accept any such intuitive conclusion, and dropped objects of different weights from a high tower in Pisa. Despite the fact that all of these objects reached the ground at the same time, "The Aristotelians," wrote Galileo, "ascribed this effect to some unknown cause, and preferred the decision of their master to that of Nature herself." But Galileo had won his fight—for the essential need for man to think for himself was established. This was another stirring revolution born of science. Again, however, its effects spread slowly—there was plenty of time for adjustments.

OTHER basic discoveries brought tremendous changes in the social, political, and economic life of large sections of the world. In 1769 the patenting of the first successful steam engine by Watt helped usher in the factory system and the Industrial Revolution. In 1828 the synthesis of the organic compound urea marked the birth of synthetic chemistry and pointed the way to the chemical revolution which gave men drugs more potent, food more nourishing, dyes more beautiful, and rubber, plastics and fuel more serviceable than they had ever possessed before. In 1831 the discovery of electromagnetic induction simultaneously by Faraday in England and Henry in the United States made available a new torrent of power, and pushed the world into the electrical age.

But none of these advances were as global, rapid, and revolutionary in their effects as the splitting of the atom. The achievement of a controlled chain reaction in the first successful uranium pile at the University of Chicago on December 2, 1942 was really something new. It was vastly different from any and all of the previous triumphs of the laboratory. The new age of nucleonics will have a deeper and more immediate impact on the daily lives of every member of society. No other group of scientific discoveries of the past brought with it the terrifying possibility that mankind could, by the pressing of a button, commit suicide. We have, therefore, very little time to play with the grim implications of this threat. International control of atomic energy based on the closest unity

Continued on Page 91

This and That

NORMAN R. D. JONES
Vice President of the National Science Teachers Association

St. Louis Meeting

Judging from the many fine reports of the large number in attendance, the program was well received. A number of the papers will appear in later issues of the Science Teacher.

The special auditorium session Thursday morning at Southwest High School, honoring Jules Kernen, the $2,400 winner of the Science Talent Search, had the following platform guests: A. O. Baker, Hubert J. Davis, Edith R. Force, D. L. Gamble, James Gebhardt, Emil Massey, Morris Meister, Greta Oppe, Margaret Patterson, and Reuben T. Shaw. Dr. Watson Davis was the speaker.

Summer Meeting

The next N. E. A. meeting will be held at Buffalo, New York, beginning July 1st. This will again be a limited meeting as at Pittsburgh 2 years ago due to travel conditions. However, it is suggested that you contact your N. E. A. Local, District or State Association organization and secure an appointment as a delegate to the N. E. A. Representative Assembly. Then you can be there to participate in *our* meeting also. *We will be looking for as many of you as can be there.*

New Directors

Miss Ruth Cornell, 1806 Van Buren St., Wilmington, Delaware.

Mr. James M. McArthur, Orleans Parish School Board, New Orleans 13, La.

Mr. Elmer Headlee, 221 E. Argonne, Kirkwood, Mo.

Mr. Robert K. Lampton, Box 724 R. R. 2; Toledo 6, Ohio.

Mr. Kenneth Vordenberg, Withrow High School, Cincinnati.

Mr. Worthy Kanarr, 1821 W. Oakes, Tacoma 6, Washington.

Miss Dela J. Patch, Science Center, Seattle, Washington.

Miss Julia Armstrong, Mott Public Schools, Mott, North Dakota.

Miss Lenora N. Bilger, University of Hawaii, Honolulu 10, Hawaii.

Changes of Address

Those of you who will be in a new location next year, please notify us of your new address.

News

It is indeed with regret that we note the death of one of our faithful state directors, Mr. Paul T. Nerhus of Fargo, N. D., who passed away on February 7.

A former president, Miss Mildred Fahy, principal of the Helen C. Peirce School in Chicago, signed her name on a recent communication Mildred F. Shea. Best wishes are extended to you.

Mr. A. S. Kent, of Caldwell, New Jersey, is working on the science revision committee of Essex County.

Sr. Lebron Ortiz was recently re-elected president of the Puerto Rico Science Teachers Association.

New Affiliations

Southern California Science Teachers Association.

Detroit Metropolitan Science Club.

New York Federation of Science Teachers.

Physic Club of Philadelphia.

Iowa Science Teachers Association.

American Nature Study Society.

Legislation

Has your State, Area, City or Local organization passed a resolution supporting Senate Bill 1316, The High School Science Education Act of 1945, and sent word of it to the Education and Labor Committee (and us.)

The following have recently reported passing such a resolution:

National Association of Biology Teachers.

Central Association of Science & Mathematics Teachers.

Missouri Science Teachers Association.

Suburban Science Teachers of Philadelphia.

Central Ohio Science Club.

New Orleans Unit. American Nature Study Society.

Information for publication concerning S.

Continued on Page 93

The Science Masters' Association

G. H. J. ADLAM

Chairman, Science Masters Association — Wells, Somerset, England

We are pleased to present this article written at the request of Mr. Norman Jones, vice president of the National Science Teachers Association, to acquaint the membership with association work in England.—Editor.

The Science Masters' Association.

Knowledge of the National Science Teachers Association of the United States has only recently become widespread in England, but already a number of English science teachers, I understand, have made application for membership. As chairman of the Science Masters' Association I have been asked to write a brief account of the activities of our parallel Association in England for the benefit of American science teachers. Needless to say we should be delighted to welcome Americans as members of our association but there is still a paper shortage in England, making it impossible at present to print more than a limited number of copies of our journal. We have a few members in different parts of the British Commonwealth and, in addition, five hundred copies of our journal are sent out, under the auspices of the British Council, all over the world.

The Science Masters' Association had its origin 46 years ago in a small group of school science teachers and it has grown steadily until today it represents the great majority of English "public schools" and "grammar schools." Speaking generally these schools educate the ablest 10% of the school population in England.

The objects of the association are to promote the teaching of natural science in secondary schools; to afford a means of communication among science masters, and with other bodies; and to issue a journal and other publications dealing with the teaching of natural science in schools.

The School Science Review

ALL MEMBERS of the association receive copies of its journal, the School Science Review. Before the war this was published quarterly, but is at present issued only three times yearly.

Despite wartime difficulties and their aftermath, each issue has maintained about 150 pages of reading matter in addition to advertisements of apparatus and books. The contents of a typical issue include articles of a general nature, technical articles giving information not to be found in text books, notes on experiments and demonstrations devised by individual teachers, reviews of science films and books, and notes and correspondence in which controversial issues are debated. Perhaps a selection of titles of recent articles may help to give an impression of the scope of the journal,—The Impact of Science on Human Beliefs, The Social Relations of Science, Science in an Indian School, Evolution and Entropy, The Cathode Ray Tube in Elementary Radio Demonstrations, Coated Lenses, Lesson Notes on Osmosis and Osmotic Pressure, Another Presentation of Organic Chemistry, The Potato and its Ailments, On Spiders Webs, Field Work in an Introductory Biology Course.

The Annual Meeting

IN NORMAL times the association holds a three day meeting at the beginning of January, alternately at the University of London and at the university of a provincial town, such as Oxford, Cambridge, Manchester and Bristol. This meeting is a source of great pleasure and profit and members look forward to meeting old friends and making new ones. On the first evening the President for the year gives his address and members in the past have had the opportunity of listening to such eminent men of science as Lord Rutherford, Sir J. J. Thomson, Sir Ronald Ross, and Sir Archibald Geikie.

During the mornings other lectures are given, and in the afternoons visits to various factories, gas works, broadcasting stations, telephone exchanges and other places of scientific interest are arranged.

A most valuable feature is the Members' Exhibition in which experiments and demonstrations devised by individual members are

set up in the laboratories for the duration of the meeting. Members sometimes bring along a laboratory assistant or senior pupils to demonstrate the purpose and working of their apparatus.

The manufacturers of scientific apparatus and the publishers of text books also provide most useful and comprehensive exhibitions.

At the Annual Meeting a business meeting is held at which the officers and members of the General Committee are elected and matters of policy are discussed.

Committees

Much of the most valuable work of the association is done by committees. In normal times standing committees criticize the examination papers in science set by public examining boards and by the Universities of Oxford and Cambridge for their open scholarships. Syllabuses are constantly revised and, when necessary, representations are made to the appropriate quarters urging reform.

In the years just before the war the association published two reports on general science, putting forward a recommended basic science curriculum for the schools. General science has been a source of controversy among English science masters. To some it means a unified course in which the distinctions between the separate sciences are obliterated; to others, and they are probably the majority, it means largely the fundamental principles of physics, chemistry and biology to serve as a basis for subsequent education, whether specialized science courses in the higher forms of schools and in the universities, or the general, adult education of the non-specialist layman.

Last year a committee of the association drew up a course in science for school arts specialists (pages 16-18), the majority of whom will have done a course in general science up to the age of sixteen. The fundamental intention behind the course is to present science as a major shaping force of civilization in its historical aspect and as a social function in the modern world.

ANOTHER committee, in collaboration with members of the Physical Society of London, has recently produced a list of recommended symbols and definitions for use in physics teaching.

A "Science and Religion" group, while strictly not a part of the association, is growing up under its auspices and has arranged a meeting to be addressed by a prominent "Modernist" bishop at the next annual meeting. Many science masters feel that what they teach in the schools must inevitably influence, possibly subconsciously, the religious outlook of their pupils, and they are concerned to clarify in their own minds their fundamental religious convictions.

Branches

Branches, formed of members of the association in certain regions of the country, conduct meetings and visits during the year. It has been found that they can be of real assistance to new and inexperienced teachers and they provide a means of social intercourse and of the exchange and acquisition of professional information.

Membership

OUR MEMBERSHIP is exclusively male, but the School Science Review is distributed to the members of the kindred association of Women Science Teachers. The majority of our members are science teachers in public and grammar schools, but some belong to the staffs of universities and technical colleges.

We are at the moment considering a widening of our field of membership. Like all recent wars, the one just ended has inspired educational reforms and chief among these is an effort to improve the provision of secondary education for the mass of pupils outside the public and grammar schools. We are proposing that masters teaching in any type of secondary school shall be eligible to join our association, but that those who do not possess a university degree shall become associate members, at least for five years, with a slightly lower subscription and no voting powers. The proposed annual subscription for members is twelve shillings and sixpence, and for associate members ten shillings. Both members and associate members will receive all the publications of the association.

Microbiological Vitamin Assay Methods

B. CONNOR JOHNSON

University of Illinois Urbana, Illinois

VITAMINS were originally recognized in the laboratory because they were required in the diet of experimental animals. It is natural, therefore, that the first assay methods were those in which the response of the animal served as an index of vitamin content. As the chemical and physical properties of the vitamins became known, chemical and physical methods were introduced for many of the vitamins.

Many of the recently discovered water-soluble B vitamins, however, were first recognized as growth factors for microorganisms. Nicotinic acid was found to be a growth factor for *Staphlococcus aureus* in 1937 a few months before Elvehjem showed that it was the anti-pellagra vitamin. Inositol, pantothenic acid, and biotin were first recognized as growth factors for yeasts, inositol being the first component of the yeast bios complex to be isolated and identified (1928). During this time other B vitamins (thiamine, riboflavin and pyridoxine) which had been shown previously to be essential for animals were likewise found to be required by various microorganisms. These specific requirements of various microorganisms for the B vitamins have led to the development of some of our most useful assay methods for these vitamins. The fat-soluble vitamins A, E, and K and vitamin C have not been found to be required by microorganisms and, therefore, these vitamins cannot be assayed for microbiologically.

The general principle of the microbiological vitamin assay technique is the same as that used in one type of animal assay in which groups of animals are fed a basal ration deficient in the vitamin being assayed but complete in all other nutrients. With one group of animals a standard curve of growth response is obtained by supplementing the basal ration with varying amounts of the vitamin being assayed. A source material containing an unknown amount of the vitamin is added to the ration of a second group of animals, and the growth response with the unknown material is compared with that of the standard curve. The amount available to the animal in the food fed can then be readily calculated.

SIMILARLY by growing a microorganism which requires a given vitamin on an otherwise complete medium deficient in this vitamin and noting the amount of growth obtained at various levels of vitamin supplementation, a standard growth response curve can be obtained, and the amount present in an unknown can be determined by interpolation of the growth response obtained with the unknown, on the standard curve. Only a few animals can be used in each group in such an animal assay, but billions of microorganisms can be grown at each level in the microbiological assay.

The first microbiological assay method which had both the simplicity and accuracy necessary for a widely acceptable method was the *Lactobacillus casei* method for the determination of riboflavin. For several years, Dr. W. H. Peterson has been studying the growth factor requirements of the lactic acid bacteria and the riboflavin assay was an outgrowth of this work. The original procedure as proposed by Snell and Strong in 1939 has been changed very little and is used extensively.

The growth requirements of yeasts also have been studied widely since 1901 when Wildiers first described bios as an unknown factor required by yeasts. Later investigations have revealed that bios contains several components of the B complex, and at least three of th B vitamins, inositol, biotin, and pantothenic acid, were first recognized by virtue of their growth-stimulating effect on yeast. Thus yeasts, too, can be used as vitamin assay organisms.

THE earliest microbiological assay involved the use of a mold. The *Phycomyces blakesleeanus* mold method for thiamin was introduced by Schöpfer in 1935, but did not gain popularity chiefly because of lack of specificity. More recent advances in the use of molds as vitamin assay organisms have been made by Dr. Beadles and co-workers at Stan-

ford University as an outgrowth of their work with the Neurospora group of molds. Dr. Beadles has found that by means of x-ray or ultra-violet irradiation, it is possible to produce single gene mutations in this mold. Some of the mutants differ from the parent strain in that they have lost the ability to synthesize a particular vitamin and, therefore, the vitamin must be supplied in the medium. Mutant strains of Neurospora (crassa or sitophila) have been produced which require such B vitamins as pyridoxine, p-amino benzoic acid, choline and inositol, and they can be used in the assay of these factors.

In table one are listed a few representative bacteria, yeasts and molds taken from the large number which have been proposed for, or are being used for, vitamin assay work. The method of measurement of the growth response and the sensitivity range of the assays are also given.

This list includes the organisms most widely used in each group. Generally, however, one assay method for each vitamin has been preferred. For instance, *Lactobacillus arabinosus* is practically always used for the assay of nicotinic acid, although at least seven

Continued on Page 86

TABLE I.

Bacteria

Vitamin	Microorganism	Assay Method	Range of Assay
			Micrograms
Thiamin	*Lactobacillus fermentum 36*	Turbidity	0.01-0.1
	Propionibacter pentosaceum	CO_2 production	0.002-0.25
Riboflavin	*Lactobacillus casei*	Acidity	0.03-0.5
Nicotinic acid	*Lactobacillus arabinosus*	Acidity	0.02-0.5
Pantothenic acid	*Lactobacillus casei*	Acidity	0.03-0.1
	Lactobacillus arabinosus	Acidity	0.02-0.2
Pyridoxamine and/or *Pyridoxal* (related to vitamin B_6)	*Streptococcus lactis R* (also called S. faecalis R)	Turbidity	0.001-0.01
	Lactobacillus casei	Turbidity	0.0001-0.001
Biotin	*Lactobacillus arabinosus*	Acidity	0.0001-0.002
p-Aminobenzoic acid	*Lactobacillus casei*	Acidity	0.0001-0.005
	Acetobacter suboxydan	Turbidity	0.005-0.04
	Yeasts		
Thiamin	*Saccharomyces cerevisiae*	CO_2 production	0.5-2.0
Nicotinic acid	*Monilia lactis*	Turbidity	0.01-0.2
Pantothenic acid	*Saccharomyces carlsbergensis*	Turbidity	0.01-0.4
Pyridoxine	*Saccharomyces carlsbergensis*	Turbidity	0.0005-0.005
Biotin	*Saccharomyces cerevisiae*	Turbidity	0.00002-0.001
Inositol	*Saccharomyces cerevisiae*	Turbidity	0.1-1.0
	Molds		
Thiamin	*Phycomyces blakesleeanus*	Wt. of dry mold pad	0.00005-0.01
Pyridoxine	*Neurospora sitophila* (pyridoxineless)	Wt. of dry mold pad	0.05-1.0
Biotin	*Neurospora crassa*	Wt. of dry mold pad	0.0001-0.003
p-Amino benzoic acid	*Neurospora crassa* (p-aminobenzoicless)	Wt. of dry mold pad	0.015-0.25
Inositol	*Neurospora crassa* (inositoless)	Wt. of dry mold pad	10-40
Choline	*Neurospora crassa* (cholineless)	Wt. of dry mold pad	2-50

Museum Junior Curators Have No Time for Delinquency

WILMA HARPER

Los Angeles High School — Los Angeles, California

THAT CLUBS combat delinquency is a well-known fact; that clubs serve as a basis for building future citizens through companionship and learning is an even better-known fact. However, a club does not accomplish its purpose for young people unless it has active enthusiastic support from authorities in the subject or the material to reach a visual goal. In 1944 the Los Angeles County Board of Supervisors authorized the County Museum of History, Art and Science to start a program for young people interested in science. These trained students were to go back into their neighborhoods and found clubs, thereby absorbing and constructively guiding some of the energy which might otherwise have gone astray.

Each secondary school in the Los Angeles system was allowed to recommend five outstanding science students who would later make good leaders. The enthusiasm of the schools was shown by the large crowd on the first day at the County Museum. Students were assigned classes in entomology, ornithology, botany, marine biology, paleontology, mammalogy and herpetology. The teacher for each group was a well-known science authority in his field. Each class ran two and one-half hours every Saturday morning for twelve weeks. After a student had completed two classes and a leader's course, he was ready to form a club.

THUS THE Los Angeles County Museum Juniors Association stretched its fingers into the secondary schools, and the Los Angeles High School formed the Museum Junior Curators, (each club is permitted its own name such as the Micro Club, Explorers, etc.). Each club sends a member to serve on the council of the Museum Junior Association. A general Association meeting is held for the entire membership of the clubs on the first Saturday of each month. At this time the clubs exchange ideas and report to each other on progress of work. The Curators have a limited membership of twenty members from the tenth to the twelfth grades. This low number was necessitated by the wide diversity of projects, but will be gradually increased as the older members become trained leaders. Cabinet meetings are held once a week with the sponsor, and the club holds meetings once a week for two hours after school, although each member spends much time before and after school almost every day on the individual projects. After the business of the meeting, which includes a short progress report on each project, one member tells the club of his activities. As one member stated, "We are really interested in all science and therefore want to know what is going on in all projects." These lectures are always illustrated with materials the speaker has collected or displays he has made. Besides personal collections, materials from the County Museum and Nature Department of the Los Angeles Board of Education are utilized. Original ideas are sometimes used to present material such as the 2x2 slides one member made by drawing with india ink on tissue paper and putting it between two cardboards. Once a month the club has a special speaker, such as Dr. Raymond Cowles of the University of California at Los Angeles, who gave a demonstrated talk on poisonous snakes, or Mr. York Escalante of the Nature Department of the Los Angeles Board of Education, who demonstrated classroom and museum methods such as collecting, preserving, and caring for live specimens. Guests at these meetings include the science clubs from the surrounding junior high schools and the members of the staff of the County Museum. The sponsor is chosen by the club and approved by the County Museum. The members operate their own club with a minimum of direction from the sponsors.

The Curators of Los Angeles High School were fortunate from the start because the school houses two large well supplied museums, one of which, the Gilbert Museum, is

an extensive collection of fossils from the famous La Brea Tar Pits. The other museum contains zoology material. The Curators were put in charge of both museums, which led to the necessity for planned action. The election of club officers included a director and assistant director of each museum. The museums are opened to the school public every Friday noon with the Curators as guides. Classes can enter at any time. The Club museum, where projects can be displayed, is one of the greatest assets for inspiration, project incentive and satisfaction in accomplishment.

EACH Museum Junior has his own individual project or works with another Curator on the same project. These cover such subjects as ornithology, entomology, photomicrography, botany, herpetology, mammalogy, paleontology, mineralogy and marine biology. The paleontology group obtained permission to dig on the edge of the La Brea Tar Pits. The pieces of bone were cleaned and identified. This necessitated a knowledge of the skeleton which was part of the pre-project preparation. This group cleaned and mounted small skeletons of rodents and birds. They revolved one display in their museum so their projectp rogress could be shown to the school each week. The mineralogy group learned the language of mineral identification before collecting in the field or attempting ot identify museum specimens. The Photomicrography project has been to learn to project slides from a microscope and to take microscope pictures with a common camera. Culmination of their project was to demonstrate to another club that this could be done with ordinary school equipment. The 2x2 projector was used as their light source for the pictures and projection. Members have also learned to make slides and have made photographs for entomology, botany and zoology. When the club started, the museum did not have a botany department, but at present an extensive collection of local plants is on exhibit. The Arthropod collection was meager, but now contains local specimens of most of the orders of Insecta and Arachnida. Since Los Angeles is located near the ocean, the marine biology section has a fine collection of local shells and sea plants and animals. Ornithology first learned to mount and make study skins of birds, then identify the local birds and have ended their current work with two display groups of local birds. This collection is not complete, as they used only dead specimens which were brought to school by students.

ALONG with the individual projects the members have kept cages of live animals and plants in order to study behavior, ecological relations, and life histories. To obtain this material has necessitated many pleasant field trips during which field behavior, habitat, and ecological relations were studied.

Interspersed throughout the program has been the party which has served as a gesture of appreciation to guests and a gay note to the otherwise serious activities of the group. The club has its own stationery for invitations.

The complete success of the club has been due to the individual help each student receives from the expert staff of the County Museum, since each has given an unlimited amount of time and information to the members. Also the hearty cooperation of many parents has made possible the short but numerous field trips and has transmitted to the member the fact that he is a vital part of the great American family.

THUS FAR the activities of the club have been limited only by the lack of time. The capacity of the members is also limited by other studies. However, activities of the Museum Juniors have served as material for the journalism classes from whom the club receives considerable publicity in the school paper. They have served as material for English papers and oral reports about countries in foreign language classes. Art students draw and paint the exhibits. Science classes have been given personally conducted tours by the Curators, which has further developed leadership in the club. The public about the school has been generous in collecting and contributing material. Many students now say, "Give it to the Curators; they will do something with it."

For immediate results the County Board of Supervisors are accomplishing their goal to decrease delinquency; but in a longer view we can see the useful citizen of tomorrow because of opportunity in youth.

Ionization

GRETA OPPE

Ball High School

Galveston, Texas

MY CHIEF argument against the standard treatment of ionization in the average high school text are that the usual treatment is too technical and does not explain the real purpose of ionization or the part it plays in chemical reactions. Beyond the battery and the process of electrolysis, there is little in texts as they are written of practical value to the student; and yet, it is possible to present ionization in a simple way so that students can use the information.

I was never conscious that I was using the electrolytic apparatus in a unique way to get over ionization. It was the remark of a man from a scientific house that made me aware of what I was doing for my students. He said that he had never seen anyone use the conductivity apparatus for that purpose and that most teachers used it to show conductivity and let it go at that.

For some weeks my students go on experimenting without much attention to theory, accumulating experiences and learning chemical principles until they can answer the questions what are the smallest things in the world and why do they act as they do. Silver Burdett published a chart some years ago that seems to me the finest approach to ionization. The chart was called "Man's Progress in the Understanding of Matter," and it traces the developments that lead us to believe in atoms and molecules; but says the chart:

> "Even though the work of the earlier chemists had solved many of the problems of chemical action, there still remained many questions about solutions. Svante Arrhenius (1883) while still in school in Sweden, proposed the theory of ionization to answer some of these questions. According to this theory when certain substances dissolve, they tend to dissociate, or break apart into ions carrying electric charges. It is the degree of dissociation which determines the action of acids, bases, and salts and the electrical conductivity of other solutions."

THERE IS A cue. Atoms explain puzzling things, but they cannot explain everything. Man needed something to explain radicals. For example, if a piece of zinc is placed in dilute sulfuric acid, it does set the hydrogen element free, but it does not make zinc sulfide nor zinc oxide but zinc sulfate. Why is this? The theory of ionization says compounds in solution don't always dissociate into elements (atoms) but into ions, particles that differ from atoms in that they may be single atoms or radicals. This particle is electrified and can attract other particles. Now bring out the conductivity apparatus to show this conductivity and to explain what substances do ionize (electrolytes) and which do not (non-electrolytes) and to teach the meaning of the terms, weak and strong.

And what else can we learn from this theory? Ions impart properties to solutions. Solutions are observed for color. All copper solutions are blue, and all cobalt solutions are pink. Solutions are observed for common taste. All acids taste sour due to a common ion. And what about test reactions that are ionic? All acids turn blue litmus red, all hydroxides (bases) turn red litmus blue; all chlorides act with silver nitrate. So we are helped to see that chemical action in solution depends upon our little particle, the ion. The farmer sweetens his soil with lime because he wants the OH ion to counteract the acid in his soil; the laundry uses a vinegar rinse because the acid will neutralize the hydroxide in the soap; and you may counteract acidity of the stomach by a dose of baking soda or of milk of magnesia. What better place to talk about nutrition and the values of Fe and Ca? The study of ionization concludes with its application to chemical equilibrium and the conditions for making a chemical action stop—a non-ionized unionized substance as a product. And remember neutralization is the union of the H ion with the OH ion and hydrolysis is the action of the ions of water upon certain salts.

Continued on Page 90

A Home Made Storage Battery and Charger

HERMAN BERLIN

Franklin K. Lane High School Brooklyn, New York

THE STORAGE battery and charger described below were constructed by the writer to solve the problem of replacing dry cells as a source of low voltage direct current. The materials used are easily procured by most science teachers. The construction is simple enough for any pupil accustomed to the use of hand tools. If the few details concerning care are followed, this unit should prove superior to dry cells. The latter become useless even when lying on a shelf. The storage battery may be charged sufficiently in an hour to demonstrate a bell, light, induction coil, or other low voltage device. In fact, the current may be drawn from the battery even while it is on charge.

This storage battery consists of three wide-mouth glass jars, each about 6 inches high and about 2½ inches in diameter. They contain sulphuric acid, specific gravity about 1.200. The jars are placed on a wooden base and held in a row by low partitions. A wooden bar about 1 inch square and 10 inches long is placed on the jars. A pair of lead plates, each 1½ inches by 6 inches, is suspended in each jar from the bar. The plates are clamped between the center bar and a similar bar placed outside of the plates and bolted to the center one. This method was found to be more durable than screws through the plates because of corrosion caused by the acid fumes. The three wooden bars should be protected first by a coat of asphaltum paint or hot tallow.

THE PLATES are then connected by wires, preferably lead-covered, as shown in the diagram. The wires are soldered to the tops of the plates. The joints and wires should be given a coat of asphaltum paint or grease.

The charger consists of an electrolytic rectifier and a 100 watt incandescent lamp. The rectifier consists of an aluminum rod or wire placed in a concentrated solution of dibasic ammonium phosphate. The container is of iron and is used as the negative electrode or anode. It is made by burning off the tin from a "tin" can in the blue flame of a Bunsen burner. The inside of the can is then cleaned with fine sandpaper. A wooden bar placed across the top of the can holds the aluminum cathode.

In use, the water of the solution is decomposed and must be replenished. A lead plate may be used for the anode and a jar for the container. The iron can, however, will dissipate heat faster. The solution lasts longer and will not decompose if the temperature is kept down. Normally, the solution does not become warmer than 114°F.

A CONCENTRATED borax solution may also be used, but the ammonium phosphate is most often used. The aluminum becomes coated with a thin film of aluminum hydroxide which has the peculiar property of offering a higher resistance to the passage of an electric current in one direction than in the other. Thus, it rectifies A. C., changing it to

Continued on Page 95

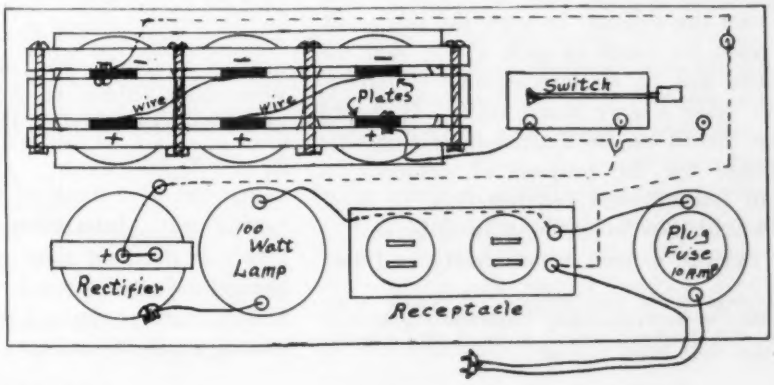

Diagram showing arrangement of battery charger

Science for Society

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Today the world faces a terrifying prospect, unless we follow the ways of peace. Soldiers, who have seen the horror and the futile waste of war, are ready to travel any honorable road to lasting peace. Whether the world can find and stay on that road depends in a large degree on the teachers of the world. It is up to the schools to provide future generations in all the countries with education leading to a respect and understanding for the people and the problems of every nation. For your own part, you should teach your pupils to abstain from prejudgment of other nations and races and to strive for as full a knowledge as possible of America and the rest of the world, without hatred and without prejudice.—Dwight D. Eisenhower, Chief of Staff of the War Department, greeting the Tenth Annual Education Conference of the New York Teachers Union, C. I. O., March 2, 1946, at the Hotel Commodore, New York.

Social Responsibilities of the Scientist[1]

DIRK J. STRUIK

Massachusetts Institute of Technology Boston, Massachusetts

Apprehension for the Future

TYPICAL of the state of mind of many among us is a feeling of apprehension concerning the future, an apprehension which ranges from an uneasy wondering of what is going to happen to a decided feeling of impending evil. It is always related to two fields, that of international politics, and that of science and technology. There is close relation between them, which few persons fail to notice. It is usually expressed by saying that if we do not come to a satisfactory form of international cooperation, then science will continue full speed to create the most fantastic weapons of destruction.

This situation constitutes a challenge to the scientist. He should be able to see the relation of cause and effect with keener perception than the average citizen. He must perceive that the relation between the two problems must be stated in such a way that the emphasis will be on international collaboration to make science more useful. It should not be placed on an extension of scientific knowledge for the purpose of enforcing a kind of international collaboration, or what what would pass for collaboration in such a case. Science cannot unfold freely and usefully under a *Pax Americana*, or *Pax Anglo-Americana*, as some people seem to think. Neither can it flourish under a *Pax Sovietica*, as the leading men in the Soviet Union well know. The primary social responsibility of the scientist is the same as that of all citizens, the promotion of genuine international collaboration.

War With the USSR?

THIS EXPRESSION is rather vague. Can it be made more precise? Let us realize that under present conditions only one major war is possible, a war between the USA and the USSR. It is an awesome fact that we even have to take this possibility into consideration, but it is forced upon us by talk and activity around us. There are indeed persons in influential positions who seem to prepare us for this catastrophe by organizing a war of nerves. The first task of the socially minded scientist, which he shares with every responsible citizen, is work for collaboration and friendship between the United States and the Soviet Union.

We can also think of this task in the following way. International collaboration depends in the first place on the smooth functioning of the United Nations. But, the United Nations depends for its smooth functioning on the harmony between the so-called

1—Contribution to the panel discussion on "Science in the Atomic Age" at the Tenth Annual Educational Conference of the New York Teachers Union, C. I. O., at the Commodore Hotel, New York, March 2, 1946.

Big Five. Members of the Big Five, on their part, are not equal in power and importance, but, for the harmony of their relations, need the mutual understanding of the Big Three. And the Big Three, finally, can only function in harmony if the Big Two, the USA and the USSR, can work together.

Soviet Peoples Friendly to Us

IT IS A fortunate thing that this understanding between the USA and the USSR is within reach. The peoples of the USSR are very friendly to us, as all visitors to the Soviet Union have repeatedly reported. Distrust of the Soviet Union, existing among a number of people in this country, is mainly based either on ignorance of the facts or on a lack of understanding, that is, on misinterpretation of the facts. This means that fuller and better information on the activities and the ideas of the Soviet Union can help to create that atmosphere of good will in which peace can flourish. It is possible to believe that the people of the United States can be led to feel as friendly and unprejudiced towards the people of the Soviet Union as they feel towards France or even towards Canada.

Scientist's Objectivity Needed

Because of his training in objectivity, the scientist can perform an outstanding service in the promotion of friendly understanding. In case of gossip and rumor he will ask for documentation. In case of quotation out of context, he will ask for full quotation. He should know, more easily than others, how to lay his hands on decisive source material. He is trained to lift the non-essential from the essential to find the main link in the chain of evidence. Once he has understood the importance of the collaboration of the Big Two, he is able to contribute to this goal unmoved by war hysteria, spy scares or horror stories.

There is another factor which makes it possible to think that we have a fighting chance to make the science useful to mankind, and to prevent destruction. The new developments in science have appeared in a world in which fascism has received a tremendous blow. Though not killed, the beast is severely wounded in vital spots. Democracy is on the march. Let us recognize it everywhere it is appearing, not only in our American labor movement allied with considerable sections of the middle class, or in large sections of the British Labor Party, but everywhere in the liberated countries, in Poland, in Jugoslavia, in China and in colonial countries like Indonesia. Wherever these democracies are rising, the common man is taking a hand in determining his own destiny. The common man wants peace and security. The rise of the new democracies thus lays a broad foundation for peace. We can say that, in the long run, the fertile development of the new science is tied to the new democracy.

THE UNFOLDING of the democracies will be a long process, but it will tend to frustrate the resurrection of fascism. Mankind still has a breathing spell to get acquainted with the new possibilities of science, and to lead it into constructive channels. Atomic energy, for example, may perform marvels in bringing prosperity to undeveloped and poverty stricken regions, where the large majority of the population of the earth is living.

Scientist a Worker

Let scientists realize that, as a group, they have lost the privileged position which the solitary scientist of a previous generation enjoyed. Science now is teamwork, scientists are in the same social category as other white collar workers. The average position of the scientific worker and of the science teacher is determined by the labor market. Victory of labor, necessary to raise the average standard of living and to ensure full employment, means also the rise of the average standard of living of the worker in science. But, it means far more. It actually means the victory of constructive over destructive science.

WE CONCLUDE that there is hope for science, if we can insure the victory of the democratic forces at home and abroad, and the establishment of good relations with the Soviet Union, two goals which again are deeply interrelated. As to our immediate task in connection with the future of science in this country, we should urge all men and women to achieve the most democratic control of the new energy, and to secure the widest government aid for research and scientific education, again under the best pos-

sible democratic control. We recommend the proposed McMahon bill (S1717, for civilian control of atomic energy.—Ed.) and the proposed combined Kilgore, Magnuson bill (S1850, for establishment of a Science Foundation, support of research, etc.—Ed.) Both represent important steps in this direction. The fathers of this country placed the military under civilian control. Let us emulate them by placing the military use of science, and above all the new source of energy, under civilian control.

The possibilities of modern scientific development are enormous. Men can see the fulfillment of the old dream embodied in the saga of Promethius who stole the fire from heaven. Shelley saw the vision of a world with Promethius unbound. Poets and philosophers dreamt of possibilities which are turning into stark realities within the span of our own generation. Atomic energy is only one aspect of many new developments which are revealed in other branches of science—in physics, in chemistry, in biology and in medicine. We need not be afraid of these possibilities if we understand and assume our obligations as citizens. It is a hopeful sign of the times that the scientist is beginning to realize that he has the responsibility of the citizen, not simply as the voter or a community man, but by virtue of his very vocation as a scientist. He is beginning to realize that being a citizen of the United States, the most powerful country, brings with it special responsibilities of citizenship. He does well to ponder this and to act upon it.

Russia and the atom—here are two powerful potential friends. They can and must be made our actual friends.

A Seasonal Change Direct Ray Apparatus

SAUL I. SIEGAL

Abraham Lincoln High School

Brooklyn, New York

AN IMPORTANT concept in understanding change of seasons is the difference in heating ability of a direct, perpendicular ray and an indirect ray. Parallelism of the earth's axis, inclination of the axis to the plane of the earth's orbit, and revolution around the sun together produce changes in the length of daylight hours as compared with hours of darkness. In addition they change the latitude of the direct noon ray of the sun. It may be established that latitudes receiving direct noon rays of the sun receive more insolation than other latitudes on that day. It may also be developed that the closer any place is to the latitude receiving the direct noon ray, the more nearly perpendicular will its noon ray be. The sun will pass through the sky at a higher elevation and the daily insolation received will be greater than that received by latitudes further removed from the position receiving the direct noon ray. Hence, the closer the region is to the latitude receiving direct noon rays, the higher its daily average temperature should be, if all other conditions are equal.

The apparatus described below may be used to develop these concepts. It shows in dramatic fashion how the direct noon ray travels from the Tropic of Cancer on June 21 south to the equator on September 23, continuing its southern journey to the Tropic of Capricorn on December 21. It begins its northern journey to pass the equator again on March 21, and reach the Tropic of Cancer on June 21.

Let us now consider the seasonal changes for Cityville in the North Temperate Zone. Cityville will receive most insolation when the direct ray reaches a latitude closest to it. June 21 therefore represents a summer date for us, and similar reasoning establishes the seasons for the equinoxes and the December solstice.

THUS, seasonal change is related to the latitude position of the noon direct ray and the apparatus shows how parallelism, inclination and revolution change this position moving it north and south between the Tropics of Cancer and Capricorn. Students are aided in understanding the climate differences in the

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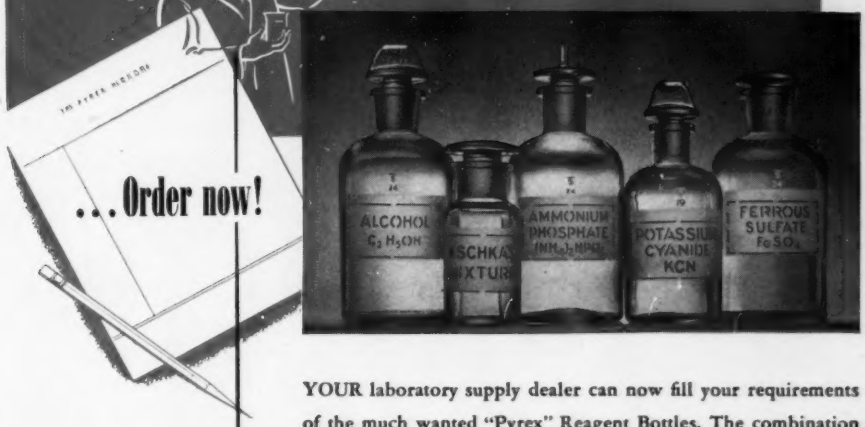

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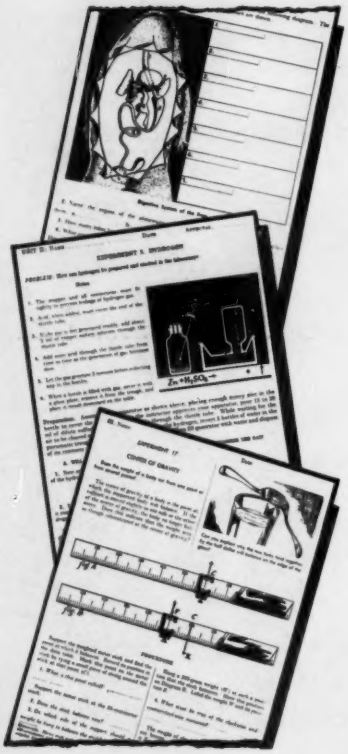

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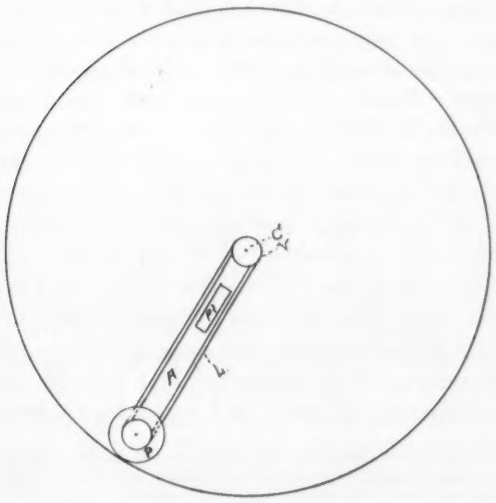
Torrid, Temperate and Frigid Zones. As the earth is made to revolve around the flashlight sun, the student sees the apparent journey of the noon direct ray. The apparatus is inexpensive, not too difficult to construct and is recommended even if the school owns factory-made season change apparatus. Students understand its construction and seem to grasp the significance of parallelism and inclination easier. Further it often motivates some students to project construction.

It is hoped that the top and side views of the apparatus together with the construction hints that follow will enable those interested to make it.

In figure 1 is shown the top view of the swinging arm "A" mounted on a circular base. The base is of three-ply wood, 36 inches in diameter, and is braced to prevent warping. The arm is pivoted around a dowel at the center "C" and can swing around that joint. The wooden pulley at the center is fixed to the dowel, which in turn is fixed to the base and does not pivot or turn. At the outer end of the swinging arm is a three-ply platform "P" fixed to a wooden pulley which pivots, or turns, on a wooden dowel fixed in the platform. The side view in Fig. 2 shows the arrangement. "Pl" in Fig. 1 is an elevated platform, or galvanized iron cradle, which carries a flashlight. A leather belt "L" is put around the center pulley and the one at the end of the swinging arm.

Fig. 1. Top view of swinging arm on a circular base.



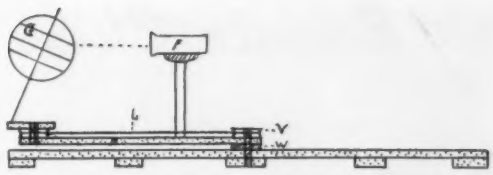


Fig. 2. Side view showing globe and flashlight in position.

In figure 2 is shown the side view of the apparatus with a globe "G" and flashlight "F" in position. The globe is inclined to the same degree as the earth's axis. It should have the equator and tropics clearly marked. The flashlight on the elevated platform (on swinging arm) is directed at the center of the globe. The swinging arm "A" pivots about the dowel fixed to the center of the base, while the belt about the fixed pulley causes the pulley and platform carrying the globe to turn.

Construction hints:

1. The wooden pulleys must be the same size. They are easily turned on a lathe by a shop man.

2. The three ply base is backed with half inch board strips to prevent warping.

3. The height of the flashlight support is obtained by placing the earth in the June 21 position as shown in the diagram. The ray of the flashlight should then fall upon the Tropic of Cancer. A front flange left on the galvanized iron cradle allows for further adjustment.

4. The leather belt should be sufficiently taut to pivot the globe platform when the swinging arm revolves around the base.

5. If the globe is secured to the platform in such a way that it is easily removable, another with an upright axis may be substituted for it to show the importance of inclination.

Suggestions for using the apparatus:

1. Point out that the flashlight is mounted so that its ray is the noon direct ray of the sun.

2. The earth is made to revolve in its orbit by swinging (A) around slowly. The axis will maintain parallelism. The direct noon ray will travel south to the Tropic of Capricorn and north to the Tropic of Cancer in one complete revolution.

Continued on Page 93

Science Clubs at Work

Edited by DR. ANNA A. SCHNIEB

State Teachers College Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

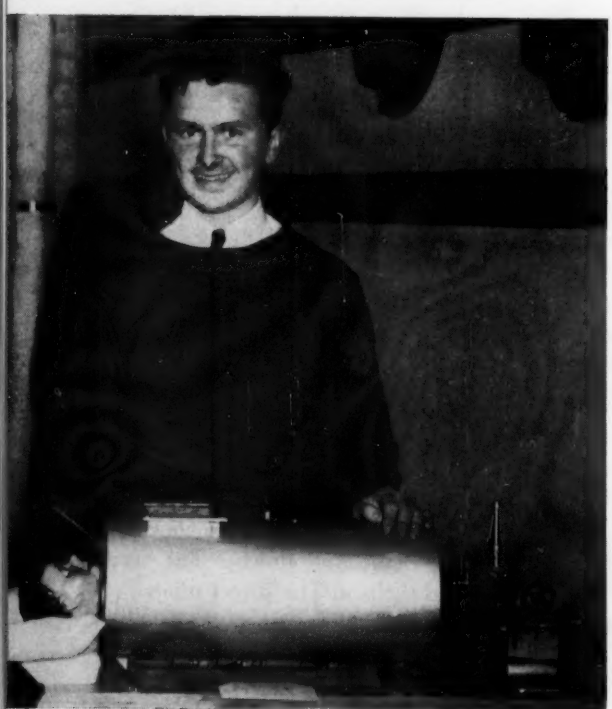
Syracuse University Science Congress

RICHARD R. ARMACOST

Syracuse University Syracuse, New York

IN RECENT years public attention has become more and more focused on science and its many applications to our way of living. This emphasis has been increased by wartime conditions which have involved a constant use of scientific material and scientifically trained personnel. The end result has been that every community finds its citizens hearing and learning more about some of the numerous recent developments in the various fields of science.

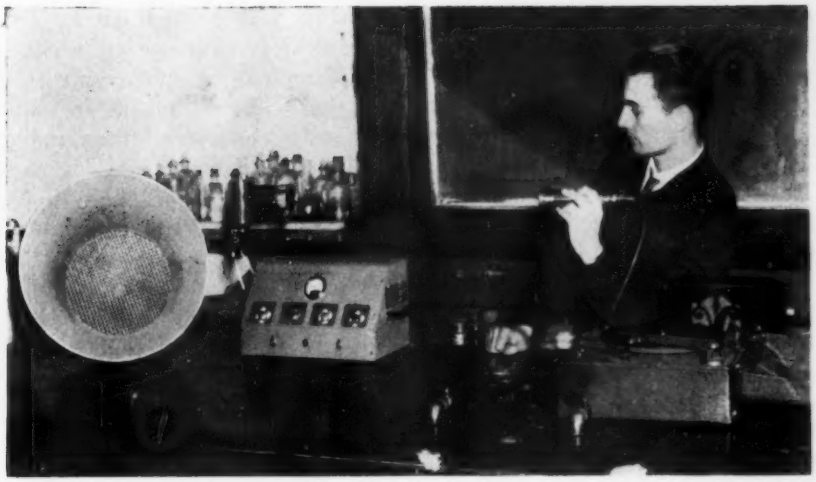
An "Iron Lung" in operation.
(Courtesy The Syracuse Herald Journal)



This general community interest in science has been apparent to many science teachers. Youngsters have frequently asked intelligent questions about subject matter that is not included in the curriculum. In addition parents have taken a greater interest in the kind of science their children learn at school. The keener teachers have recognized this situation as an excellent motivating force, and have used it to the advantage of their teaching. The more alert school administrators have been eager to show the science-interested inhabitants of their communities what a fine job the school does in teaching children science.

One very effective way of providing an opportunity for a community to learn some of the results of a school science program is through organized science clubs. These clubs encourage students to work on individual or group projects, preferably during school hours, and to culminate the year's work by showing their creative products at a science congress to which all persons in the community are invited. Since 1939 public and parochial schools in the Syracuse, New York, area have profited further by participation in a larger science congress[1] sponsored for their schools by the Syracuse University School of Education, with cooperation of all the science departments in the University's College of Liberal Arts. The Syracuse Science Center, located at the University has come into existence. Its purpose is to encourage and to help the organization of junior and senior high school

1—The Science Center has not held a congress during the last two years because of wartime transportation difficulties. Tentative plans have been made for a 1946 congress.



Photophonic communication

(Courtesy The Syracuse Herald Journal)

science clubs, and to provide an annual science congress where selected pupils from schools in thirteen upstate New York counties may come and compete with one another by displaying science exhibits and giving brief talks about work they have done on some particular phase of science.

THE SYRACUSE University Science Congress is a one day meeting held on the University campus. Students from the junior and senior high schools can participate in either or both of two main categories of competition. Category A is reserved for entrants who give brief talks (not more than fifteen minutes) and provide demonstrations of the work they have done. Category B is provided for those participants with exhibits only. Junior and senior high school students are segregated, and parallel programs and awards are provided for each division. Students in both the junior and senior divisions are encouraged to participate in category A because of the profitable experience of talking to an audience about their work. It has been noticeable that judges have usually reacted favorably toward participants in this category. Members of the various science departments of the University act as chairmen at sessions of this meeting.

The types of subject matter presented in the past have varied. For example, talks have been given about: Light and Color; The Heart; Life Long Ago; How the Modern Radio Works; Principles of Gas Masks; Effect of Air on Bodies at Rest; Fluorescence; Air Conditioning; Chemical Warfare; Plastics; Blood and the War; Vitamins; Modern Applications of Polarized Light; and other subjects.

Exhibits have included displays which have explained: Defective Feet, Man's Defeat; Manufacture of Sulphuric Acid; The Photo-Electric Cell; The Principle of the Submarine; Syracuse Water Supply; Rockets; Color Photography; Manufacture of Coal Gas; Model Coke Plant; Maps of Bird Migrations and Races of Mankind; and other applications of science.

Major Problems

IN POINTING out the many benefits derived from participation in a meeting such as the Syracuse Science Congress, one frequently paints a one-sided picture. It must therefore be openly admitted that many problems are involved. It is hoped that an analysis of the major difficulties may help others in planning for or participating in a science congress. Some of these difficulties are: a rather general lack of interest by senior high school students; a scarcity of willing and competent science club sponsors in the junior and senior high schools; the difficulty in selecting suitable projects for students; securing competent judges; determining the type of awards or recognition to be given at congresses; the decision as to whether local science clubs should affiliate with a national organization of science clubs or remain independent.

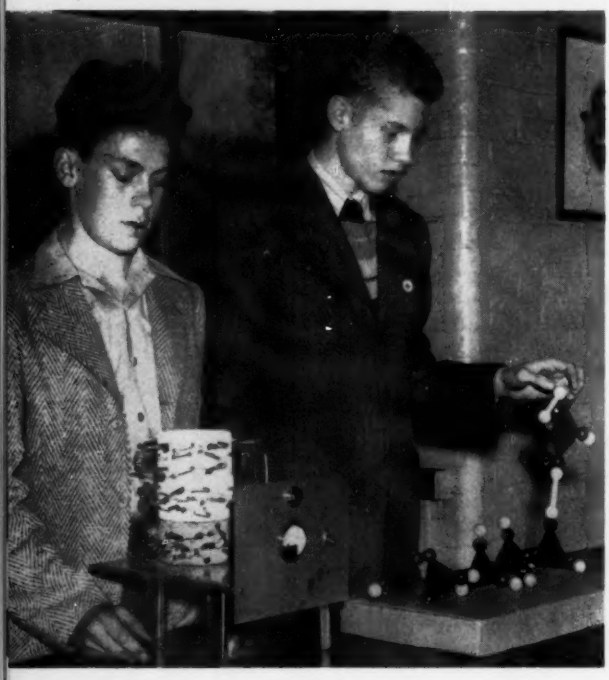
Without a doubt the lack of willing and

competent science club sponsors affects many of the above problems, particularly the absence of interest by senior high school students. High school seniors are also interested in many other activities, both curricular and extra-curricular, which makes time a limiting factor. Finally, all upperclassmen recognize the fact that competition is keen and unless they are interested in science, perhaps even to the extent that they have begun certain specialization, they are not going to give time and effort to science club work.

The most common excuse of competent science teachers who do not sponsor science clubs is that such work is impossible under their present overloaded schedule conditions. Today their excuse is a statement of fact. When more administrators see that science club activity fills an important need for boys and girls, teachers' schedules stand a better chance of being revised to include this type of educational activity.

MOST OF THE difficulties in the selection of projects stem from lack of imagination on the part of the teacher, or pupils, or both. The best projects year in and year out are those which develop from the basic classroom program. They usually represent the type of subject matter a whole class might not find interesting or profitable for further study. However, certain individuals learn much by continuing work in these chosen areas. They then report their findings back to the whole class so that all may profit from their efforts. What better way is there for taking care of individual differences? For those who can't think for themselves, or are too tired to try, many books and booklets are published which list a variety of projects in many different areas. (i. e. Science Clubs of America: "1000 Projects for Science Clubs of America". Washington, D. C.).

Generating electricity by thermocouple; models of molecules. *(Courtesy The Syracuse Herald Journal)*



Selection of judges for the Syracuse Science Congresses has been a major problem. Past experience indicates that the best committees of judges are composed of representatives of industry, teachers and supervisors of junior and senior high school science, and college professors of science who are interested in the accomplishments of boys and girls. It is necessary to select a committee which includes members with specialized training and interest in physics, chemistry, biology, geology, and general science.

Many attempts have been made at the Syracuse Science Center to set up criteria to aid in more objective judging. All of these have helped, but the answer to this problem of evaluating such varied types of subject matter is still wanting. Some suggestions for the judges have been to base their decisions on: originality; creative ability; ingenuity in development; interest value or appeal, including dramatic aspects; clearness; accuracy and effectiveness of presentation; economy both of time and money spent; thoroughness; neatness; and technical skill involved. In the end, however, the judges have had to consider these suggestions as a whole and decide which participants had done the best all-round job. Point systems have been tried and found decidedly objectionable. After a given judge has chosen what he considers the best talks and exhibits, he briefly records specific reasons for his choices, and then joins his fellow judges for a round table discussion of the relative merits of all choices made by the entire committee. In this way a cooperative

Designing and testing a motor powered plane

(Courtesy The Syracuse Herald Journal)

agreement is reached. If stalemates occur, equal recognition is given the participants involved.

Awards

AWARDS are a headache! Many pros and cons have been written and spoken concerning the desirability of various types of rewards for students participating in educational programs. It has been the opinion of those directing the activities of the Syracuse Science Congresses that awards should be more or less of the traditional kind—the type we are accustomed to in our every day life. In the 1941 congress a scholarship to Syracuse University was the major award.

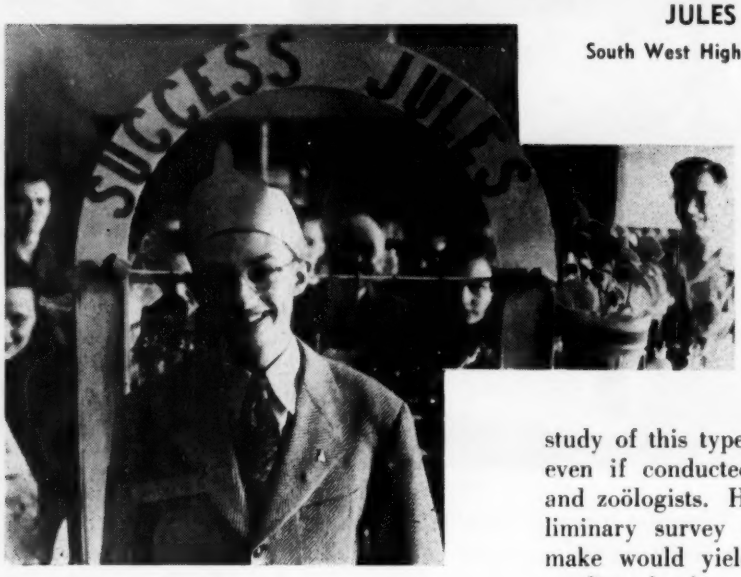
The year a university scholarship was awarded, many hidden obstacles appeared. Strangely enough, none were connected with the procurement of the award. In the first place, the scholarship had to be restricted to senior division students in the twelfth grade or post graduate program because most universities do not like to award scholarships to students not planning to enroll in college within a year. This necessitated uneven awards for contestants within the senior division of the congress, and between the senior and junior divisions. Secondly, some students had no intention of entering any college or were uncertain of entering the college from which the scholarship was offered. Finally, students who may win scholarships on the basis of proficiency in a science congress may not be eligible for college entrance because of many types of deficiencies including their total school scholarship record. War bonds and stamps were more satisfactory as awards, but probably the best type of recognition of success should involve something that would aid a winner of a science congress to develop further his interests and aptitude in science.

Scientific Chicken Raising

(Courtesy The Syracuse Herald Journal)

Experiences of One Westinghouse Scholarship Winner

JULES A. KERNEN
South West High School
St. Louis, Missouri



Jules takes leave for Washington, D. C.

WIDESPREAD interest has been aroused recently by the annual Westinghouse Science Talent Search. In many high schools throughout the United States, the highest ranking science students, as they enter their senior year, discuss among themselves their projects for the Science Talent Search and the competitive examination that they will take. This article has been written in the hope of giving these students a clearer conception of what they may expect to see and do in Washington if they should become trip winners.

Although I had been engaged in miscellaneous minor scientific experiments since the eighth grade, I did not begin the actual planning of this project until the end of my junior year at high school. Since I had previously collected insects and had also conducted various experiments in nutrition, I thought that it would be interesting to commence an ecological survey of a large lot located near my home. Ecology is the study of the relationships between animals and plants and their environments. Although it might seem to be a fairly simple task to catalogue the organisms of a limited area and then study each species individually to see what factors influence its development, a comprehensive study of this type would require many years even if conducted by experienced botanists and zoölogists. However, I knew that a preliminary survey of the type that I should make would yield valuable information regarding the fauna and flora of the area and would also demonstrate the amazing complexity of life here on earth. During the summer months last year, I collected specimens from the area and made observations concerning the life histories of many of the species and their adaptations to a particular type of environment. The results of this survey and a classified list of the two hundred and forty-five species of animals and plants found on the area were submitted as my essay for the Science Talent Search, together with the examination and other information required by the Board of Judges.

EARLY ONE morning toward the end of January, I received a telegram from Washington stating that I had been selected as one of the trip winners for the fifth annual Science Talent Search. It is certainly a very thrilling experience to receive such a message as this, a message which meant that one would be given a trip to Washington, all expenses being paid by Westinghouse, and would, therefore, be eligible to compete for the Westinghouse Grand Science Scholarship. I departed from St. Louis on February 28 and arrived in Washington early the next morning. Following is a condensed journal of my trip in part and my visit at the Science Talent Institute.

Friday, March 1. Arrived in Washington

early this morning. Most of the morning was spent in settling ourselves in the Statler hotel and in meeting the other winners. Each of us had three fifteen minute interviews, one with each of the judges, Dr. Steuart H. Britt, Dr. Harold Edgerton, and Dr. Rex Buxton. The two former are psychologists; Dr. Buxton is a psychiatrist. Late this afternoon we visited the White House and had punch and cookies with Mrs. Truman.

Saturday, March 2. This morning three very interesting lectures were given. Dr. Perrin Long, Director of the Department of Preventive Medicine, Johns Hopkins University, spoke on "Medical Research During the War". He presented a lucid summary of the innumerable advances in medicine that resulted from the exigencies of the wartime emergency. Dr. Glenn Seaborg, Professor of Chemistry at the University of California, spoke about the new chemical elements: Neptunium, Plutonium, 95, and 96. Dr. Seaborg, who has contributed to the development of the atomic bomb, discussed the fundamental principles of the bomb. Finally, Dr. Selman Waksman, Microbiologist at the New Jersey Agricultural Experiment Station, told us about penicillin, streptomycin, and various other antibiotics.

This evening we exhibited our projects at the Statler Hotel. All of the trip winners have been required to bring with them some exhibit to illustrate the type of scientific work in which they have been engaged. I was highly impressed with some of the truly outstanding work done by winners; in my opinion, all of them deserved high recognition. Most of the sciences were represented by one or more exhibits; botany, zoology, bacteriology, mineralogy, physics, chemistry, astronomy, and photography—all of these things were studied by one or more of the winners. During the course of the evening, we were addressed by Miss Marina Prajmovsky, Grand Science Scholarship Winner of 1942, who spoke about her experiences at the Harvard Biological Laboratories.

Tuesday, March 5. Today was the big day! Tonight, at a banquet in the Presidential Ballroom of the Statler Hotel, the winners of the Grand Science Scholarships were to be announced. During the morning our group participated in a Senate hearing about the legislation recommended in the Vannevar Bush Report. After the hearing had concluded, we were taken on a tour of the Capitol, where we spoke to Senator Kenneth McKellar and saw the United States Senate in session. Later we visited the Supreme Court and viewed the proceedings of that body. During the afternoon, some of us participated in a tour through the National Naval Medical Center at Bethesda, Maryland. We were all highly impressed by the magnitude of the research operations that were under progress there; among the many laboratories that were inspected, were included those housing the electron microscope, the high pressure chambers used for training deep-sea divers, and the high-altitude chambers for development of equipment used in high-altitude flying.

In the evening the awards were presented by Watson Davis and the Board of Judges. Dr. E. U. Condon, Director of the National Bureau of Standards, gave the address of the evening. Finally, at the close of the dinner, $2.400 Grand Science Scholarships were presented to Marilyn Rohrer of Elizabethtown, Pennsylvania, and to me. Late this evening, we bade good-bye to most of the other winners.

In retrospect, I can honestly say that the trip to Washington was the greatest event in my life. I sincerely hope that all high school seniors who are interested in science and who desire to work on a project of their own will enter the competition this fall. Simply by taking the examination and writing about his project, each student derives much valuable experience.

One of the primary prerequisites for success in this contest, I believe, is to have done original experimentation. All the reading and studying that can be done from books will not take the place of actual laboratory or field experience. My only advice to students entering the Science Talent Search is—start your project early, know what you hope to find out, work at it conscientiously, and don't get discouraged if things do not work out as planned. The mark of true success is being able to overcome "impossible obstacles".

Photo Club Activities

AARON GOFF

Cleveland Junior High School — Newark, New Jersey

SINCE the intrinsic interest in things photographic has probably been heightened by the wartime shortage of film, more boys and girls than ever are participating in photo club activities. While the principal objectives of any such club must continue to revolve around picture taking, developing and printing, there are a large number of related activities which have always been possible with such an interested group. Such activities serve as stimulants and vitalizers, incorporating, as they do, member participation, techniques of demonstration and easy to do projects.

Following is an outline of some that have been tried successfully with different groups over a period of years:

1) The precipitation of silver chloride by the reaction of silver nitrate with salt solution, introduces the light sensitive substance which actually darkens in sunlight after a few minutes. Exposure of dry, sensitized paper, especially enlargement or b r o m i d e paper brings about similar darkening after a day or two. This may be compared with the action of developer on briefly exposed paper.

2) A package of cut film (purchased out of the club funds) size 3¼x3¼″ serves as the source of several activities. A discussion and demonstration describing the nature of film, using one sheet to illustrate, may end with the effect of a developer in darkening the originally white surface. (All done in an illuminated room.) The effect of warm developer (80°-90°) on the gelatin may be shown easily, as well as the hardening action of the fixing solution.

3) Preparation of gallon quantities of developer (the best all purpose one is probably Eastman's D-72) and acid hypo solutions may form the basis for an interesting meeting with a few of the officers being set to work, mixing the ingredients in their proper sequence. Members who wish to do work at home may purchase small bottles of developer and fixer at not too great a profit to the club. The importance of using dark bottles—filled to the cork (to exclude oxygen) may be vividly shown by setting up a specimen bottle of clear glass and one half filled with developer. The action of light and of oxygen is shown within a week or two by the darkening and formation of sediment.

4) Members' cameras may be studied, (preferably while empty), and, when viewed with their backs open and held to the light, diaphragm openings and shutter speeds are readily demonstrated. Members themselves may wish to describe their own cameras and discuss their advantages and disadvantages. A piece of ground glass held to the open back of a camera, with shutter open, renders visible the inversion and focussing action of the lens.

5. A prism held in such a way as to disperse sunlight on a wall or white sheet, may also be used to study artificial light. The differences in the two spectra are immediately apparent, especially if they can be thrown side by side from two prisms. This analysis, of course, leads to a discussion of the nature of light, visible and invisible, which in turn brings out the need for different types of film for different lighting.

6. Pinhole cameras may be made, or purchased from Eastman Kodak Co., Rochester, N. Y. at 25c per outfit. Detailed instructions for the use and construction of these devices are given in leaflets distributed free by that company. The above mentioned cut film will fit these cameras and may be loaded in a dark room.

7. The study of the properties of printing paper may be dramatized by having each member present make a shadowgraph profile on 6x8 or 8x10 contact print paper. A classroom darkened by shades is well suited to this purpose. A reflector containing a No. 2 photoflood as a source of light or even a stereopticon may serve to illuminate the subject. The trick is to hold the paper close to the side of the face while the shadow is thrown upon it. Exposures of a few seconds, suffice with the more powerful light sources. An exhibit of perhaps the more handsome or

Continued on Page 92

An Elementary Science Program

IRENE COOGAN

Horace Mann School St. Louis, Missouri

ABOUT THREE years ago, when it devolved upon me to develop my own science program, and especially one that was to fit the needs of my pupils, I was confronted with what seemed to me an unsurmountable brick wall. My inventory disclosed on the *debit side*:

1. My own very limited knowledge in the field of science.
2. My inadequate preparation for teaching the subject.
3. A lack of scientific equipment and material in the school.
4. And few, if any, satisfactory books.

However, on the "credit side." there was present:

1. My life long genuine love of all living things.
2. Proximity of Shaws Garden and T. T. Park where there is a wealth of natural material.
3. Availability of Miss Heising's valuable assistance.
4. Proximity of Carpenter Branch Library.
5. Children who were innately curious.

Did I say "No material?" Just as soon as I suggested to my pupils a list of fish, frogs, reptiles, and insects from which we might choose, we had more specimens than we had suitable accommodations. Among the specimens list were:

1. Harmless snakes.
2. Salamanders.
3. Frogs.
4. Turtles (different kinds).
5. Chameleons.
6. Swifts (reptile family, not birds).
7. Horned toad.
8. Gold fish and tropical fish.
9. Spiders (including black widow, and trap door spiders).
10. An ant colony.
11. Caterpillars.
12. Cocoons.
13. Frog eggs.
14. Insect eggs.
15. Spider eggs.
16. Dragon flies.
17. Praying mantis.
18. Walking stick.
19. Cacti plants.
20. Baby roaches.
21. Worms.
22. Flies which provided delicious meals for many air pets.

Also listed were various aquariums, some which served fine for setting up:

1. A balanced aquarium
2. A terrarium
3. A vivarium

WITH the coming of so many pets, four major problems were suggested by the pupils themselves: (1) where are we going to keep them, (2) what are we going to feed them, (3) who is going to take care of them, and (4) who is going to feed them.

The solution to these problems *provided* a real activity program which *involved* research work on the part of the pupils and *included* visits to the library for reference books.

Some groups made suitable cages, or homes, for the specimens, while others provided the proper food and care. After the children had taken care of the elementary wants of the specimens, they were encouraged to become acquainted with them through daily observation, keeping in their note books whatever they wished, secure in the knowledge that their note books were theirs, and theirs alone, and that the teacher would never scrutinize them. The teacher noticed that not all the children were interested in the same specimens, but that their interest varied. These varied interests were expressed later when they prepared science books.

AMONG the units of work afforded by the live specimens and the pupils' observation of them, and also by numerous excursions to Shaws Garden, Tomer Grove Park, the Zoo and the Reptile House were:

1. A study of fish, emphasizing the study of its anatomy. The different parts of the fish were named by means of a diagram on the board. Its scales, fins, tail. gills, and eyes are all points of interest.

2. Study of frogs and their relatives—their life cycle from egg to adult stage—their protective coloration, their legs and their feet—their behavior and habits, and their usefulness in gardens. The children learned from

Continued on Page 82

WRITE FOR IT

The twenty-six page booklet, *Applications of Atomic Power*, contains reprints of six radio talks by staff members of the General Electric Research Laboratory. The authors are some of the men most familiar with investigations leading to the development of atomic power. Write to the General Electric Company, Schenectady, New York.

A new thirty page catalogue of *General Electric Motion Pictures* brings up-to-date the company's offerings of free motion picture and slide films available to schools. Can be obtained from the General Electric Company, Schenectady, New York.

The *World Within the Atom* is a thirty-two page booklet that will bring you much of the present knowledge of the atom and some understanding of atomic energy and its implications. It is obtained free from School Service, Westinghouse Electric Corporation, 306 Fourth Avenue, Box 1017, Pittsburgh 30, Pa.

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Engineering Highlights. A thirty-two page illustrated booklet that can be obtained free from School Service, Westinghouse Electric Corporation, Pittsburgh, Pa. It includes such challenging topics as radar, atomic power, gas turbines, atomic power, and new materials.

A sixty-four page booklet. *We Had to Have Rubber*, can be obtained from the Rubber Manufacturers Association, 444 Madison Avenue, New York 22, N. Y. It is largely a picture story of the place of rubber in the late war.

Turtox News is a very informative and helpful forty page journal of special interest to biology teachers. Free. Published by the General Biological Supply House, Inc., 761 East 69th Place, Chicago 37.

Therapeutic Notes is an excellent thirty-two page trade publication of Parke, Davis and Company, Detroit 32, Michigan. It carries much material of interest to biology teachers. The discussion of the applications of vitamins and new drugs may be of intrest to some chemistry teachers. Write for it.

Wagner Circle. An eight page quarterly trade publication of the Wagner Electric Corporation, 6400 Plymouth Avenue, St. Louis, Missouri. The December, 1945, issue contains an article by Dr. A. H. Compton on *Atomic Power.*

ELEMENTARY SCIENCE PROGRAM

Continued from Page 81

handling toads that they did not get warts, so that helped to dispel that one superstition.

3. Reptile study—their general characteristics, their helpfulness to man, differentiating between the harmless and the harmful ones, and acquainting the children with the four poisonous snakes in our country so that they will let all others live.

4. Study of insects, their general structure, their life cycle, differentiating between the useful ones and their usefulness, as bees, ants, silk worms, ladybirds, dragon flies, praying mantis, the harmful and destructive ones, and the *necessity* for and ways of combating them. There is no end to this unit.

5. Birds, their structure, identity, habits, beauty, and their helpfulness to man, followed by a unit on conservation of birds. The teachers manual on conservation put out by Missouri Conservation Commission is especially helpful.

6. Trees—their identity by leaves—leaf arrangement, bark, shape, etc., their beauty and usefulness to man, followed by a unit on conservation. One could go on forever with this unit.

7. Ants and their social life—their helpfulness to man.

8. Color protection.

9. Protection in Nature.) Both this unit and the preceding one link beautifully with "Camouflage" taught today as one of the branches of military science.

10. Balance in nature.

11. Hibernation and migration.

GRAPHOID SURFACES

Continued from Page 59

junct to regular lubricating oils it has extensive application in spring oils, upper cylinder lubricants, crankcase oils, special greases, assembly and running-in oils, high temperature, and other special purpose lubricants.

THE EVER widening application of *oildag* in many and varied lubrication problems is based upon sound reasons. These are summarized by Finch and Zahoorbux. According to these investigators, a graphoid layer (as formed on friction parts with the aid of colloidal graphite in mineral oil) provides an admirable temporary substitute for an orientated oil film. Its peculiar layer-lattice structure enables the graphite to exhibit its own lubricating properties. Under normal operating conditions of adequate oil lubrication, the graphoid layer will be completely covered with an orientated oil film that serves to prevent well run-in surfaces from coming into contact either with each other or with the graphoid layer or layers with which they may be covered. If, on the other hand, the oil film becomes ruptured, the orientated graphoid layer is virtually as effective as the lubricant in permitting ready shearing between the two bearing surfaces. It is thus possible for a bearing with graphitic surfaces to run dry for considerable periods without *seizure*. This is of extreme importance to motorists, who, if they use a colloidal graphite oil with the regular crankcase oil, need never fear dire consequences if, for one reason or another, their engine oil should become entirely used up. Motorists have driven thirty to fifty miles with the crankcase empty, yet the engine parts suffered no damage because they were adequately protected by a graphoid layer.

3. *High Temperature*: Below 600°C. graphite resists oxidation. Hence colloidal graphite in graphoid surfaces is an excellent high temperature lubricant. The inertness of graphite is an important quality since the rate of decomposition of an oil and its reactivity above 300° C. increase rapidly with small increments in temperature. Colloidal graphite, therefore, is capable of withstanding the majority of high temperature conditions encountered in lubricating practice.

The Graphoid Layer in the Electrical Field

BECAUSE of its extreme versatility, graphite, neutral and synthetic, has found application in a wide range of industries. The synthetic variety because of its great purity is finding increasing application in the field of electronics. When colloidalized and dispersed in liquid carriers, the graphite, in addition to retaining its original properties, takes on all those unique qualities associated with matter in the colloidal state.

The first of these characteristics is that each minute particle carries either a positive or negative electrical charge, dependent upon the nature of the liquid in which it is dispersed and the type of ion it has adsorbed. Hence the particles do not settle out because of the Brownian movement and also because of the repulsion each particle suffers when it approaches a neighboring particle with its electrical charge of the same sign.

Graphite, when colloidally dispersed in suitable carriers, may be applied to surfaces to form, upon drying, continuous films which are opaque, unctuous, chemically inactive and electrically conductive. Such films are low in photoelectric sensitivity, have a low coefficient of expansion, are good thermal conductors, have good *getter* properties and are effective absorbers and radiators of heat. All of these properties are utilized in the manufacture and operation of electronic devices.

Electrostatic Shield

IT SHOULD BE remembered that graphite shows little photoelectric effect. It is, at the same time, remarkably stable under electron bombardment, making it an excellent coating material for metals and glass which are subjected to the impact of primary particles. Coatings produced with aqueous graphite dispersions may be applied to the exterior of vacuum tubes that require electrostatic shieldings. A typical example is the FP - 54 Pliotron which acquires surface charges simply by handling. These tend to leak off through the control grid circuit, appreciably increasing the grid current. It is therefore, recommended by the manufacturer of this tube that *Aquadag* be applied to the bulb as an external coating to within an inch of the control grid connection. This impro-

vised shield is then connected to a source of potential equal to that of the grid, thus bringing about the dissipation of any charges which may have accumulated on the bulb.

A very practical application of this shield protection is employed by the manufacturers of electric pianos to prevent humming. Instruments, such as electric pianos are especially sensitive to stray alternating electrostatic fields. By painting the inside cabinet surfaces, with an aqueous suspension of colloidal graphite and grounding the coating so produced, hum-free performance is obtained.

The rectification of alternating current by means of copper oxide rectifiers necessitates the intimate contact of the rough crystalline cuprous oxide (Cu_2O) disks with adjacent disks or plates. In the early models, this was achieved by insetting soft metal washers between the elements. Upon mounting the parts on a threaded rod and exerting pressure with a nut, it was hoped that the flow of soft alloy would produce the desired effect. The deformation of the metal was imperceptible, however, resulting in the adoption of colloidal graphite as the contact agent. When the oxide layers are sprayed with dilute *Aquadag*, the graphite fills in the cavities between the crystals to yield a smooth surface affording a large contact area.

HIGHLY concentrated aqueous dispersions of graphite, having the consistency of a paste, are commercially available. This material makes a useful conducting agent. It has long found practical application in the manufacture of therapeutical and other carbon filament lamps where it serves as a clamping paste for attaching the filament to the lead-in wires. It may also be employed for making connections between graphite coatings and ground wires, cat whiskers and the like, or for any similar purpose wherein positive contact under difficult conditions is required.

The foregoing uses of graphite emphasize the conducting properties of graphite. Graphite films may also be produced which make use of the resistance properties of graphite. If, for example, colloidal graphite is applied to non-conducting media like paper, glass, ceramic or resinous materials by such procedures as spraying, painting, dipping or electro-deposition, it is possible to form elements having a comparatively broad resistance range. Dispersions of colloidal graphite in phenolformaldehyde varnish have been successfully used in the production of resistors having extremely high ohmic values. Coatings rich in graphite which have undergone polishing or pressure have a low resistance, while thin films, or layers comprised of intimate mixtures of graphite and a non-conductor, obviously exhibit high resistance properties.

Light Sensitive Cells

PATENTS have been granted covering the use of *Aquadag* films in phototubes employing selenium and tellurium. The advantage of graphite over other electrode materials in this application lies in its inability to combine with selenium to form a selenide. Since the electrical conductivity of selenides is greater than that of the element itself and inasmuch as the selenide formation is usually progressive, the sensitivity of a unit containing the graphite film does not decrease with age.

Graphite exhibits a peculiar affinity for cesium, which property is also made use of in the manufacture of photoelectric cells and half-wave rectifiers. When the latter type of tube is placed in operation the heat from the filament liberates the alkali, converting it thereby, into vapor in the region between the electrodes. When the tube cools, the cesium is adsorbed by the graphite. It is stated that even should the alkali metal become affixed to the glass envelope, the metal gradually vaporizes at room temperature and is ultimately taken up by the graphite layer.

In the process of manufacture of photoelectric cells, the inclusion of a plate of metal which has been previously treated with *Aquadag* makes unnecessary the usual practice of baking the cell at high temperatures to remove excess alkali metal. The graphite treated member accomplishes this by adsorption.

General Electrical Applications

THE LIST OF applications of *Aquadag* for electrical purposes is ever lengthening. When it is painted on the insulating covering of armature conductors of high voltage alternators, corona difficulties are eliminated.

Similar aqueous paint, when used on driving belts serves to dissipate any charges that may be generated by the friction between air and the belting, the flexing of the belting and its slippage on the pulley. Colloidal graphite is effective for blackening the receivers of thermopiles, particularly those designed for use with long infra-red rays.

Non-conductors of electricity may be electroplated by being treated with colloidal graphite in a suitable carrier. Colloidal graphite is capable of being electro-deposited (electrophoresis) either alone or in conjunction with an ion in solution. Low friction copper-graphite combinations have been prepared by the method. It might be well to add that one type of resistor is prepared by electrophoretically coating stainless steel plates with graphite from an aqueous suspension. After the coating has been dried the plate is placed in contact with paper strips which have been impregnated with an uncured phenol condensation product. By applying both heat and pressure, the graphite is quantitatively transferred from the steel plate to the paper strips. Such a strip when suitably mounted on a non-conducting base, serves as a resistance unit. Variable resistors prepared in this manner find utility as volume controls in broadcast receivers.

Summary

Graphite in the colloidal state possesses extremely satisfactory lubricating powers, and forms on a metal surface what is recognized as a graphoid layer or surface. By modern methods of research and investigation it has been found that this graphoid surface does not go to pieces under stress, but rather tends to cover the metal completely, even though the crystals are reduced in size. Lubricants containing colloidal graphite provide a protection to metal surfaces, in addition to decreasing the normal amount of friction which exists. This *protection* should have a special significance to operators of internal combustion engines, especially automobile drivers, who want to be free from worry of burning out a bearing or two when the oil in the crankcase is used up.

In addition to the lubricating powers of

Continued on Page 90

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VITAMIN ASSAY METHODS

Continued from Page 65

bacteria and two yeasts have been proposed as assay organisms.

PERHAPS the best way to describe these assay methods is to outline briefly a representative assay. The *Lactobacillus arabinosus* method for nicotinic acid is one of the most satisfactory assay methods. The test organism for this assay, *Lactobacillus arabinosus 17-5* is obtainable from the American Type Culture Collection, Georgetown University, Washington, D. C. The organism is carried on stabs in a glucos, yeast-extract, agar, medium. The inoculum for an assay is prepared by transferring some of the cells from the stab to a sterile basal medium to which 1 gamma* of nicotinic acid has been added to produce growth. After incubation and centrifugation, the cells are resuspended in sterile saline solution and are ready for use.

The composition of the basal medium is given in Table 2. The samples to be assayed

*1 gamma (γ) = 1 microgram = 1/1,000,000 gram

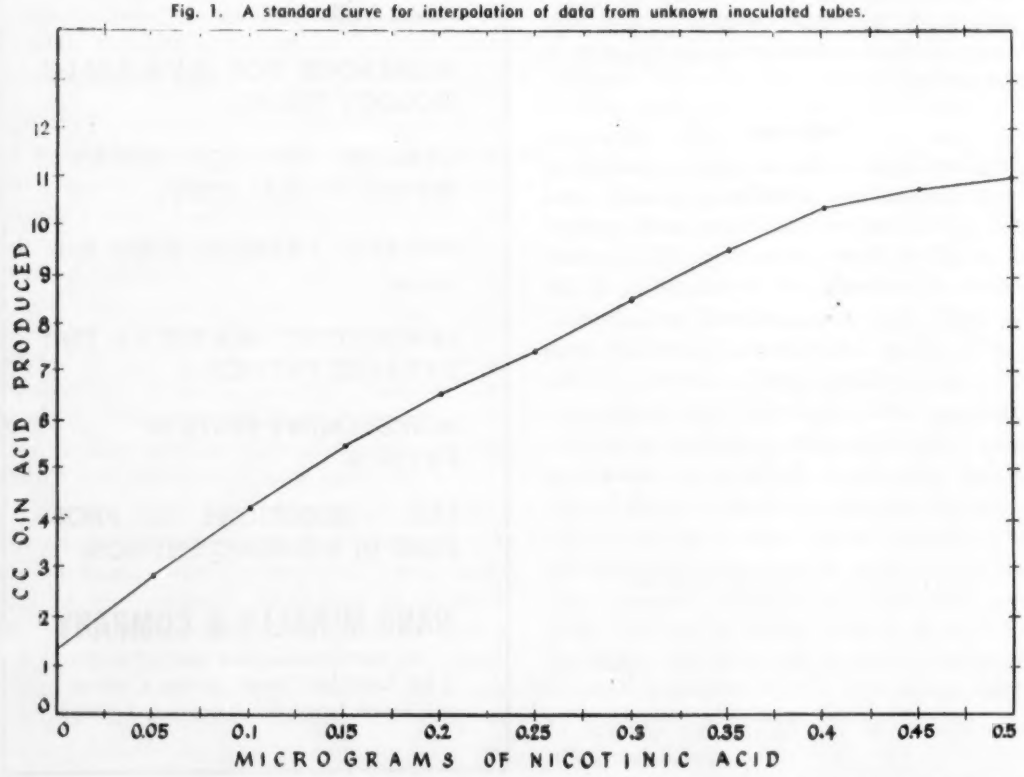
TABLE II.

acid-hydrolyzed vitamin-free casein	0.5	per cent
l-tryptophane	0.01	per cent
l-cystine	0.02	per cent
glucose	2.0	per cent
sodium acetate	2.0	per cent
adenine sulfate	10	ppm
guanine hydrochloride	10	ppm
uracil	10	ppm
riboflavin	.2	ppm
calcium pantothenate	.1	ppm
thiamin chloride	.1	ppm
pyridoxine hydrochloride	.1	ppm
p-aminobenzoic acid	.1	ppm
biotin	.5	ppb
K_2HPO_4	.05	per cent
KH_2PO_4	.05	per cent
$MgSO_4 \cdot 7H_2O$	.02	per cent
NaCl	.001	per cent
$FeSO_4 \cdot 7H_2O$	.001	per cent
$MnSO_4 \cdot 2H_2O$	.001	per cent

are prepared by auto-claving with normal sodium hydroxide or sulfuric acid, adjusting to pH 6.6 and diluting to a volume such that 1 cc. of the solution will contain about 0.04 gamma of nicotinic acid. Frequently an assay must be repeated to find the correct range.

Continued on Page 88

Fig. 1. A standard curve for interpolation of data from unknown inoculated tubes.



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The assay is carried out in standard bacteriological test tubes as follows: Twenty tubes are used for the standard curve. To these tubes are added in duplicate 0, 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.50 gamma of nicotinic acid. Aliquots of the solution or suspension of the test sample are added to other tubes in duplicate with three to five different levels for each sample. Sterile water is added to the tubes to make up to a 5 cc. volume and then the 5 cc. of basal medium is added. After the tubes have been plugged, autoclaved, and cooled, they are inoculated with one drop of the inoculum previously described and incubated at 30° C. for 3 days. The amount of lactic acid produced is determined by titration with tenth normal sodium hydroxide. The lactic acid is a product of the metabolism of the lactic acid organisms and the amount present is related to the amount of growth and metabolism that has taken place. The titration data obtained from the tubes to which nicotinic acid was added are plotted against the corresponding amounts of nicotinic acid to form a standard curve as illustrated in figure 1. Such a standard curve must be set up for each assay so that the experimental conditions for the test series and its corresponding standard series are the same. The titration data from the unknown tubes are converted into gamma of nicotinic acid by interpolation on the standard curve.

OTHER assays employing lactic acid are carried out similarly. However, for some types of bacteria which do not produce large amounts of lactic acid during growth, some other index of growth must be used. The method most generally used to measure the growth of these bacteria is turbidity; that is, the more growth, the larger the number of cells, and the higher the turbidity due to these cells in suspension. Turbidity is usually determined in a photoelectric colorimeter. This method can be used instead of the titration method for the lactic acid organism when it is desirable to cut down the assay time. Turbidity measurements can be made after 18

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hours instead of 3 days, however, the results are not as accurate and therefore the use of the turbidity method in preference to the titration method is not recommended for accurate results.

In the yeast assay methods, turbidity or CO_2 production is measured as an index of growth or metabolism. Yeasts generally are able to use simpler media than bacteria and the assay period is usually shorter. The *Saccharomyces carlsbergensis* assay method for pyridoxine, for example, gives very satisfactory results with an incubation time of 16-20 hours.

The yeast fermentation assay method for the determination of thiamin was developed in the Fleischman laboratories by Dr. Frey and his group. It is one of the best microbiological methods for the estimation of thiamin. The principle of the procedure is based on the fact that thiamin added to certain commercial baker's yeasts low in this vitamin will increase the fermentation rate of these yeasts. Under suitable conditions, this method is highly specific. The rate of fermentation is measured by the volume of CO_2 produced.

With the exception of the *Phycomyces blakesleeanus* method for thiamin assay which is used primarily by botanists, the only mold methods used to any extent are those employing the various *Neurospora* mutants. In the case of molds, the growth is generally measured by weighing the dried mold pads. Again, a standard series is employed from which the amount of vitamin in the unknown can be calculated.

WHAT are the advantages and disadvantages of microbiological procedures as compared with biological and chemical methods? Biological methods, unlike microbiological or chemical methods, measure the vitamin *activity* of the substance being assayed. This activity may include the activity of any precursors of the vitamin as well as the vitamin itself. Furthermore, the activity is dependent on the absorption of the vitamin from the intestinal tract of the animal, the metabolism of the vitamin, and the amount of conversion of its precursors in the body. In other words, the biological method measures an overall response rather than the actual amount of a

Continued on Page 96

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IONIZATION

Continued from Page 68

WHAT I am trying to say is that too frequently ions are thought of vaguely as related to conductivity only; whereas in a treatment of this kind, the ion is thought of as a particle responsible for all sorts of chemical action.

GRAPHOID SURFACES

Continued from Page 85

colloidal graphite, it is finding increasing use in the electrical field, especially in the manufacture and operation of electrical machinery. Paradoxical as it sounds, colloidal graphite exhibits both conducting and resisting properties which makes it an especially valuable and useful material for electrical purposes.

The foregoing indicates the extensive use to which colloidal graphite is being put, and when the war is over, there is little doubt that the present demands for colloidal graphite will be greatly expanded.

Literature Cited

Acheson Colloids Corporation, Technical Bulletins Nos. 220.7; 280.1.

Szymanowitz, Raymond, Electronic Industries, October, 1943.

J. Ind. Eng. Chem., 5, 717-23 (1913)

Trillat, La Science et la Vie, No. 248 (1938)

Science Progress, 31, 609 (1937); Trans. Faraday Soc., 33,425 (1937)

Kol Zeit. 39,334 (1926)

J. Soc. Chem. Ind., (1920); or Chem. News, 120,244 (1920)

"The Study of Wear and Lubrication by Electron Diffraction," Inst. Mech. Eng., General Discussion on Lubrication and Lubricants, October, 1937.

Carleton, R. K., "Colloidal Graphite — A Modern Lubricant," Chemical Industries, (1943)

CHALLENGE OF ATOMIC FISSION

Continued from Page 60

of all the peoples of the world living in mutual friendship and understanding is the only assurance of human survival. "The world is my village," wrote Tom Paine before the atom theory was even named. We of the atomic age must now accept this new relationship or perish.

NUCLEAR fission differs from all other previous achievements in science in still another way. For the first time in history the basic power of the universe is at our disposal. Science and technology have suddenly jumped a full century, and mankind has at its finger tips as much concentrated power as it needs to raise the living standards and well-being of every inhabitant of the earth, within a relatively short time. Today, six freight cars are all that are needed to carry the three hundred tons of fissionable material needed to replace the more than a billion tons of coal burned annually throughout the world. This is no wild guess. And "it is quite feasible that a city the size of Seattle should be completely heated from an atomic source in less than five years." This is the opinion of Dr. J. Robert Oppenheimer who was in charge of the final assembly of the atom bomb at Los Alamos.

When war becomes a fossil of history and society has won a lasting peace, a new world can be born in our time. This is the challenge of atomic fission. As educators and, specifically as teachers of science, we have the grave responsibility of planning broadly and acting quickly to change the content and philosophy of our teaching to accomplish two ends—to win the race of human survival against the perils of plutonium, and to prepare our pupils as citizen-scientists for the age of unparalleled abundance and fuller living which lies ahead.

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Science Projects

In Biology, Chemistry and General Science

Biology Projects

(Published, October, 1942)

Included among these projects are: loss of soil elements by leaching, test tube plants and root hairs, food elements of plants, how to make a cross section of a stem, using light to make glucose and starch, when plants breathe like people, heat of respiration in plants, what causes liquids to flow in plants, identification of trees, the house fly and what he carries, controlling insect pests, digestion, checking your posture for health, charting your teeth, susceptibility to tooth decay, making media of correct pH to grow bacteria.

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Chemistry Projects

(Revised, March, 1943)

In this group are found examination and purification of water; testing of lubricating oil, paint, baking powder, wool, silk, cotton, rayon and linen; electroplating; metal working; hydrogenation of oil; getting sugar from corn; tanning leather and fur; making bakelite, cold cream and vanishing cream, baking powder, mirrors, ink, polish, and plastic wood.

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General Science Projects

(Published, October, 1942)

Among the projects are the following: amateur range finding, how to navigate by sun and stars, weighing without scales, making and using solutions, seven ways to start a fire, seven ways to put out a fire, chemical indicators, a rock mineral collection, a pin hole camera, printing pictures, learning to be a radio amateur, a pendulum project, testing foods at home, digesting food with saliva, canning food, how good are the arches in your feet, surveying the teeth, and clay modeling and casting.

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PHOTO CLUB ACTIVITIES

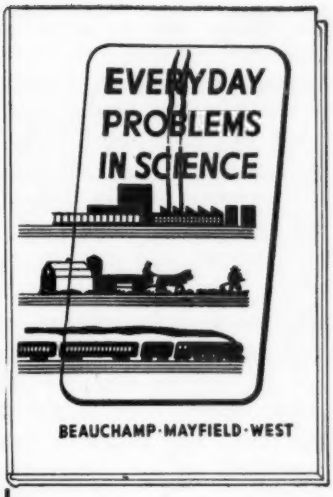
Continued from Page 80

striking profiles will probably lead to many interesting, if facetious comments.

8. The effect of light intensities on printing paper may be made by varying time (in seconds) of exposure and source. The sun shining through an open window, and then through glass, may be compared with the effect of a 100 watt lamp, a photoflood or a projector at distances of one foot, two feet and five feet.

9. For printing from negatives, which will be found to be one of the most important routine activities of any club member, a printing box is almost a must. Some of the members may desire to construct their own printers for use at home, or at such time as they may have graduated. Plans for such printers may be found in various books, periodicals and pamphlets. The circuit involves a socket for a red bulb which is in parallel with the cord, followed by a switch in series with the white bulb or bulbs. In general, two fifty watt frosted bulbs will give a more diffused illumination than one 100 watt. Diffusion is increased, of course, by insertion of a piece of opal or translucent ground glass betwen the light and the negative. An adjustable frame may serve as the top of the box and is usually more efficient than an improvised arrangement.

10. The use of printing paper in making shadow or contact prints of objects other than negatives finds several useful applications. In connection with their biology work members may produce beautiful leaf prints by using proper exposures. Veining of the leaves is often brought out in a most aesthetic manner. A pinhole camera may also, of course, be set up to take a picture of the moon as it appears to move through the heavens. More rapid cameras are necessary for pictures of star trails. Around Christmas time, silhouette cutouts combined with cut out block letters may be used to print greeting cards directly on sensitized paper. Double weight paper is recommended for these. Integration with art work may be accomplished by having designs painted on glass, which may then be used as the negative. Greeting card kits are sold by many photographic supply houses.



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THIS AND THAT

Continued from Page 61

1316 was recently mailed to our directors for their state educational journals. A *typical response* (Mrs. Gladys Nisbet, Springer, New Mexico): I also took the liberty to make a copy of the manuscript and sent it to the secretary of the New Mexico Academy of Science (of which I am Vice-President) and asked if there was some way to get action from the group as a whole.

Leaders' Training Institute

The National Science Teachers Association has been allotted a sum of money to hold *Leaders' Training Institutes*. A very successful meeting for the West Coast State and Area Directors was recently held in connection with the spring meeting of the Northern Section of the California Science Teachers Association at Oakland, California. Another was held at Denver, Colorado. Other *Institutes* are being planned for New Brunswick, New Jersey on May 4th, and for New Orleans on May 18th.

Judging from the expressions made by those in attendance at the first two meetings, this is a most worthwhile project and from the enthusiasm generated much good should result for the association.

SEASONAL CHANGE APPARATUS

Continued from Page 73

3. It may be shown that rotation without revolution does not change the position of the direct noon ray.

4. When a globe with an upright axis is substituted the direct ray stays at the same latitude. There would be no seasonal changes.

5. Develop the thought that an axis that did not maintain parallelism might cause sudden and unpredictible season changes instead of regular orderly changes.

BOOK SHELF

ESSENTIALS OF GENERAL CHEMISTRY. B. Smith Hopkins, Professor of Inorganic Chemistry, and John C. Bailar, Jr., Professor of Chemistry, University of Illinois. D. C. Heath and Company, Boston, 1946. 520 pp., 15x22 cm., 216 illus. $3.50.

Essentials of General Chemistry provides an up-to-date and accurate presentation of the principles of general college chemistry. In organization it follows the standard form for college texts in this field. However, in the treatment of material it gives more than the usual attention to the reasoning involved in the establishment of a principle or the explanation of a phenomenon, as in the case of hydrolysis, ionization and partial ionization.

Full attention is given the more important elements and their compounds. The metals are taken up somewhat in the order as found in the periodic arrangement. The metallurgy involved in obtaining each from its ore is discussed in connection with the study of the element.

Two of the objectives set up for attainment through study of the text are: "To give the student an appreciation of the importance of chemistry and to teach him to reason logically and scientifically." The text lends itself well to the attainment of these goals.

At the end of each chapter is an abundance of problems and exercises to test the comprehension of the student. Many references to current literature are also included.

PLASTICS, SCIENTIFIC AND TECHNOLOGICAL. H. Ronald Fleck. Chemical Publishing Company, Brooklyn, New York, 1945. 325 pp., 13½x21½ cm. $6.50.

The book, *Plastics*, attempts to present an up-to-date and comprehensive study of the scientific technological aspects of the plastic industry. It gives a survey of current literature and correlates it with ideas gathered from numerous sources.

Not only is the chemical theory presented, but the latest methods of manufacture are discussed with diagrams included to show possible equipment layout and design. The numerous data tables should be of considerable help to the technical worker. The author loses no time in getting to the essential points in presenting each topic and is quite clear and explicit.

The book should be of much value to the busy research worker and college teacher in the area of plastics.

TURTOX MICROSCOPY BOOKLET. A. C. Lonert. General Biological Supply House, Chicago, 1946. 43 pp., 59 illus. Free.

Turtox Microscopy Booklet is designed especially to aid the beginner in the use of the microscope, but also gives much help to the advanced microscopist. The elementary exercises and comparative studies help to teach the practical applications of microscope theory, improve technique, and increase the young microscopist's range of operations.

Following a discussion of the making and use of a fluid lens microscope, the functions of the parts of a microscope are presented clearly and in some detail. How to use the instrument is explained. The author is especially to be commended on the presentation of theory and practical helps in the correct use of illumination, color filters, polarized light, and fluorescence microscopy.

Other areas covered in the booklet are stereoscopic vision with the monobjective binocular microscope, three dimensional photography with the monocular microscope and microprojection.

THE CHEMICAL FORMULARY, Vol. VII. H. Bennett, Editor-in-chief. Chemical Publishing Company, Brooklyn, N. Y., 1945. 474 pp., 13½x21½ cm. $6.00.

The Chemical Formulary, Volume VII, gives a wealth of information as to working formulas that can be used in the manufacture of numerous chemical products. Some of the areas covered are adhesives, flavors and beverages, cosmetics and drug products, emulsions and colloids, inks and marking substances, leather and fur, photography, polishes, pyrotechnics, plastics, and soaps and cleaners. New areas introduced, or given more attention than in the preceding volumes, are farm and garden specialties, colloids, food products, and paper.

The book follows the plan of the earlier volumes in organization. Along with the formulas, typical procedures are given in each area to guide the worker. These appear to be more in detail than in preceding volumes and often give some discussion of the principles involved. The introduction to the book is especially helpful to the novice in the field, giving specific instructions in the use of the formulas.

The volume should appeal to the home chemist as well as to the manufacturer. It

offers many ideas for project work in high school and college chemistry courses.

WINGS OVER AMERICA. John Stuart, Aviation Reporter, New York Times, Public Affairs Committee, New York, 1946. 32 pp. 10 cents.

In *Wings Over America* John Stuart gives a stern warning that American air supremacy may be dissipated because of inadequate research and development and lack of planning for civilian flying. Great as is the expected expansion in air transport and personal flying during the next few years, he finds after a careful survey that the production of civilian planes will probably be insufficient to maintain an aircraft industry adequate for national security.

METEOROLOGY, George J. Brands, Chief Meteorologist, Pan American Airways System. First edition. McGraw Hill Book Company, Inc., New York, 1944. 235 pp. 22x14 cm 71 illustrations with 7 in color. $2.50.

The book, *Meteorology*, presents in a clear and concise form the necessary facts for the understanding of weather phenomena. It is particularly suited to the needs of those who need a knowledge of weather in relation to their work, particularly navigation. For class use it will be found satisfactory.

The discussions of "Cyclones and Polar Front Theory, Warm and Cold Front Weather, and Weather Forecasting from Synoptic Charts' are especially interesting and useful.

The book is made up of 16 lessons with review questions and examinations. Necessary tables are included in the appendix.

HOME-MADE STORAGE BATTERY

Continued from Page 69

pulsating direct current. To keep the cathode in good condition, it should be taken out of the solution when not in use.

A 100 watt lamp is used to reduce the current from the supply line. The charging rate may be increased if a larger lamp is used, but the solution will probably become heated more than is desirable. The rate with a 100 watt lamp is 3/8 ampere. A receptacle and plug fuse in a socket allow the full voltage of the A. C. supply to be utilized for other purposes.

Plan now for N. S. T. A. meeting to be held in Buffalo, New York, in conjunction with the N. E. A. meeting beginning July 1.

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What films for class room instruction is a yearly problem, as well as where to get them. We supply you a list of desirable films in the science area requested and also indicate where they can be obtained. It will pay good dividends to make certain that your choice of films is well made.

New Texts, Workbooks, Manuals, References and Books for Supplementary Use—

We supply a list of new books and indicate the publishers. (Second semester.)

Awards—

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News and Announcements

Atomic Research

An expansion program in the study of the basic physics of atomic power is planned by the General Electric Research Laboratory in Schenectady, New York. Eventually it will require the attention of "a substantial part" of the large research staff, according to Dr. C. G. Suits, company vice president and laboratory director.

Approximately twenty scientists who formerly were engaged on the Manhattan District Project, which developed the atom bomb, have been appointed to the laboratory since the war's end. Fourteen others receiving appointments were formerly engaged on such wartime projects as the atomic bomb or radar. A new laboratory also will be built, which will include a radiation division for the study of nuclear physics.

Books for "Blacked-Out" Countries

Countries in which the war imposed a literary "blackout" for five years are being sent a special catalogue number of the McGraw-Hill Overseas Book News, listing scientific and technical books published during that period. Some 300 books published since Pearl Harbor are included.

McGraw-Hill also announces the appointment of Professor F. E. Terman as the new editor of the McGraw-Hill Series in Electrical and Electronic Engineering.

Fellowships in Health Education

Fellowships for one year of graduate study in health education, leading to a master's degree in public health, are being offered to qualified men and women between the ages of 19 to 40 by the U. S. Public Health Service through funds made available by the National Foundation for Infantile Paralysis. There is a stipend of $100 a month, tuition, and travel expenses for field experience. Persons accepting fellowships will be expected to work in the field of health education for at least two years after completion of training. The candidate must have a bachelor's degree, and courses in the biological and/or physical sciences, sociology, and education may be required. For complete information write to the Surgeon General, U. S. Public Health Service, Washington 25, D. C. Applications must be in the office not later than June 1, 1946.

Bausch and Lomb Finalists

Twenty winners of the Bausch and Lomb Honorary Science Award will be in Rochester, N. Y., May 16 and 17 to compete for the third annual Bausch and Lomb Science Scholarships, with a value of $7,500.

The competition for the Bausch and Lomb Science Scholarships is open to students in the 4,500 high and preparatory schools that annually present the Honorary Science Award to the graduating senior with the most outstanding record in science.

VITAMIN ASSAY METHODS

Continued from Page 89

specific chemical compound present in a food or feed.

The chemical and microbiological methods, on the other hand, measure the total amount of the vitamin present without giving any information as to its availability to the animal. In most assay work, however, an actual value is desired even if this is to be followed by work on the biological activity of the vitamin in question.

The only chemical methods extensively used are the thiochrome method for thiamin and the fluorometric method for riboflavin. Microbiological methods are generally preferred for the assay of riboflavin, nicotinic acid, pyridoxine, inositol, p-aminobenzoic acid and choline and they are the only (except animal methods) available methods for biotin, pantothenic acid and folic acid. In our laboratory the microbiological methods are used if available because of their increased sensitivity, specificity, and simplicity of operation.

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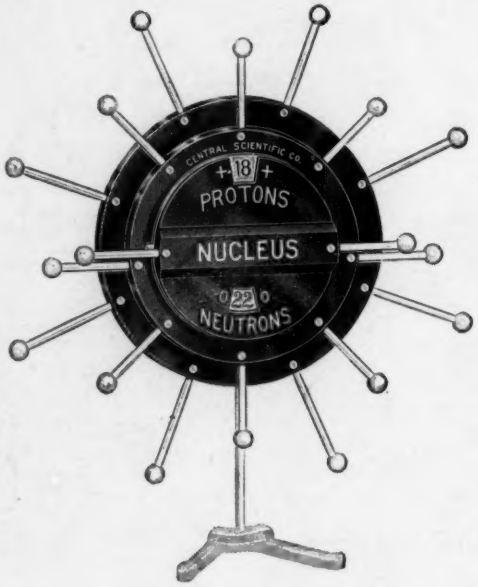

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